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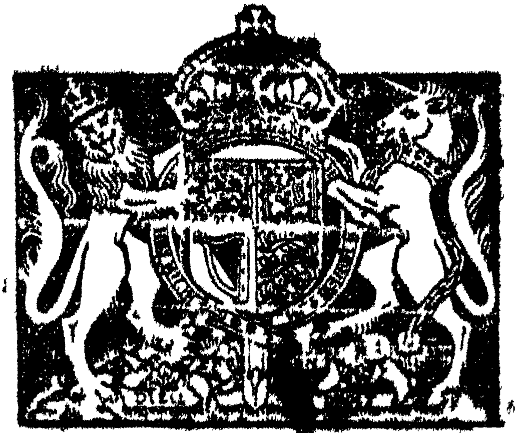

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BULLETIN OF THE IMPERIAL INSTITUTE

A RECORD OF PROGRESS RELATING TO
AGRICULTURAL, MINERAL AND OTHER
INDUSTRIES, WITH SPECIAL REFERENCE TO
THE UTILISATION OF THE RAW MATERIALS
OF THE DOMINIONS, INDIA AND THE COLONIES

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On March 17th, 1945, on the retirement of Dr. S. E. Chandler, Dr. J. R. Furlong became Principal of the Plant and Animal Products Department and Mr. G. T. Bray succeeded Dr. Furlong as Vice-Principal of the Plant and Animal Products Laboratories. An appreciation of Dr. Chandler's services to the Institute is printed on page 13.

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Reported Missing

Flight Engineer J. W. HARRY, Royal Air Force.

Killed in Action

Air Gunner R. C. WILSON, Royal Air Force.

BULLETIN OF THE IMPERIAL INSTITUTE

VOL. XLIII. NO. 1. JANUARY-MARCH, 1945

THE RIGHT HON. HARCOURT JOHNSTONE, M.P.

It is with deep regret that we record the death at the age of 49 years of The Right Hon. Harcourt Johnstone, M.P., Parliamentary Secretary of the Department of Overseas Trade and *ex-officio* President of the Board of Governors of the Imperial Institute since 1940.

He was educated at Eton, and served in the Great War in the Rifle Brigade and on the staff in France and Belgium, afterwards returning to Balliol College, Oxford, and graduating in 1919.

As Chairman of the Board of Governors Harcourt Johnstone had a quick grasp of details, sweeping away unessential elements and arriving at the crux of the problem with unerring rapidity. The meetings at which he presided were never tedious and no meeting ever ended without clear decisions having been reached and without his giving to the meeting and to the Institute wise counsel for future action.

Harcourt Johnstone will be remembered at the Imperial Institute for his keen and friendly interest in all its activities both in its scientific and technical services to the Empire and also in its efforts to promote the knowledge of the Overseas Empire in this country.

H. A. F. L.

Judging by the general appearance of the sample the gathering of the flowers had been left rather too late. It is usually considered that, in order to obtain the maximum pyrethrin content, the correct time for harvesting is when 4 or 5 rows of the disc florets are open. If the present sample of flowers had been gathered somewhat earlier it is likely that the amount of total pyrethrins would have shown some improvement on the figures recorded above. Flowers having the above total pyrethrin content would however be readily saleable.

Pyrethrum flowers grown in Kenya are the richest in pyrethrin, and are usually sold having a guaranteed total pyrethrin content of 1·3 per cent.

Prior to the war Japanese-grown flowers varied from 0·8 to 1·1 per cent. total pyrethrins, and were usually sold on a basis of not less than 0·9 per cent. total.

It will be seen therefore that the present sample of pyrethrum flowers represents a product of a satisfactory quality, and if flowers similar to these could be produced in quantity there should be little difficulty in finding a market for them.

ARTICLE

THE MARKING OF HIDES AND SKINS

By J. R. Furlong, Ph.D., A.R.I.C.
Secretary, Imperial Institute Consultative Committee on Hides and Skins

Since the quality of a hide or a skin cannot be judged with certainty until it has been worked in the tannery, it is evident that these materials have to be bought largely on trust. The reputation of the shippers in conjunction with a system of arbitration and compensation, based on working results, are the buyer's chief safeguards.

In addition to inherent characters, there are qualities dependent on the trouble taken in preparing the hide for the market, and it is as an index to these features that marking is of most importance.

This article deals only with dry hides and skins; the labelling of wet and wet-salted material is a separate problem.

In the preparation of a dried hide faults may be introduced which are not apparent in the dry hide as sold by the producer. The damage due to knife cuts and gouging may not be fully revealed until the hide has been put into work, but more hidden still in the dry state is the evil caused by faulty drying. In faulty drying putrefaction takes place, and although in some cases this may be manifested by hairslip, blister or smell, generally in appearance the hide looks sound. When soaking takes place in the tannery, however, the putrefied hide-substance dissolves, parts of the hide are lost, and the full extent of the damage is disclosed.

Much work has been done by the veterinary officers in the Colonial Empire to improve the flay, the drying, and the general preparation of hides and skins, particularly in the replacement of harmful ground-drying by shade-drying and by the highly satisfactory suspension-drying, which was advocated as a result of the experiments planned by the Imperial Institute Consultative Committee on Hides and Skins and carried out in Kenya in 1932. (See this BULLETIN, 1934, **32,** 41.) Progress has been made and suspension-dried hides, which are far more reliable than ground-dried hides, are recognised as such by the higher price which tanners are prepared to pay for them. Since a good looking ground-dried hide, although it may be faulty, cannot be distinguished on sight from a shade- or suspension-dried hide, advantage has been taken of this position by the unscrupulous dealer, the inferior type being mixed with the superior hides and the whole lot sold under the description of shade-dried hides. The result has been that tanners, having been caught in this way once or twice, lack confidence in consignments offered as shade-dried. On the other hand, if they were sure of getting suspension-dried or shade-dried hides throughout the consignment they would happily pay the full value of such hides, whereas with the knowledge that the parcel may be mixed, the natural tendency is to cover possible loss by a lower price. In this manner, with superior preparation failing to secure the increased remuneration to which it is entitled for the additional labour involved, the reaction of the native producer is very often one of opposition to the improved methods advocated by the authorities.

This handicap to the good work done by the Veterinary Departments through the lack of safeguards in marketing became so apparent that the Consultative Committee on Hides and Skins considered very carefully the question of certification and marking in this connection. The members were convinced that to ensure permanent advancement in the industry a system of marking hides and skins was essential and formed the basis for future development. It was laid down that the marking must be sufficiently permanent and tamper-proof to be easily recognised when the hides finally reached their destination, the tannery.

The marking which is recommended consists in placing a three letter mark on the hide or skin at the time of its preparation, to denote (1) country of origin, (2) district of origin, and (3) method of drying.

The advantages of indicating the country and district of origin are obvious. For instance, a consumer finds that hides from a certain district are consistently good and suitable for his purpose. He therefore demands that sort, and the official mark is a guarantee to him that he is getting what he has asked for. In this way the district producing the best hides will establish the best reputation, and this, reflected in price, will recompense the district that takes the extra trouble involved in good preparation. At the same time faults in hides can be traced easily to their source when the district is shown on the hide. Hides may be permanently damaged in the cleaning operation by gouging. A case of this nature occurred recently and concerned two consignments from East Africa, some parts of which were damaged and others sound. The paper labels which had been stuck on the hides at the time of preparation were mostly destroyed, while those remaining were illegible or very difficult to read. If the hides had all borne a permanent mark indicating the district of origin, the fault could have been referred back with ease to the appropriate authority.

Another recent case where marking would have been of great assistance was one in which goat skins sold as shade-dried were found to contain badly dried skins, which were no doubt sun dried skins fraudulently included. In this instance marks would have at once disclosed the insertion of skins contrary to the description of the consignment.

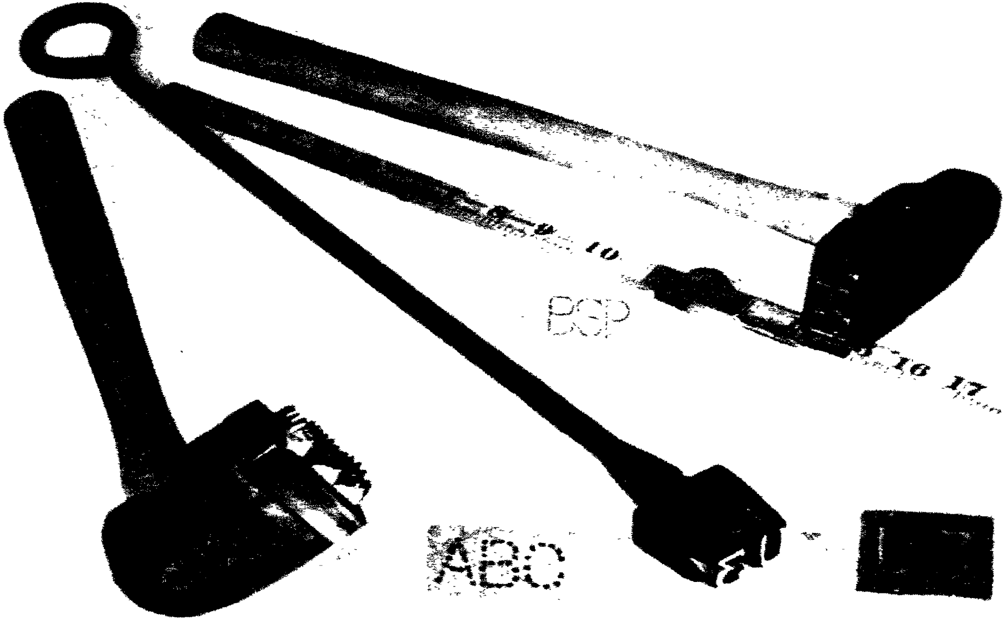
The method of drying should, as indicated above, be shown in order that the tanner may have a guarantee, distinguishing between (1) shade-dried, (2) suspension-dried on frames or other structures in the sun or open, and (3) ordinary sun-dried on the ground.

At first sight it may appear that in the marking of hides we have a method of labelling each hide with a direct value sign of its quality. In urging the adoption of marking the Committee has not advocated it for this purpose, but, as stated above, for the recognition of (1) origin, and (2) method of drying. These are indirectly an index to quality, and of paramount importance to the success of any improvement scheme, but marking with a grade number or other sign of specific quality has its disadvantages, and there are strong objections to it.

The Committee has on several occasions considered at length the question of grading, and is strongly of the opinion that any attempt to mark hides with a grade at the up-country buying centres is inadvisable. The buyers and collectors at these places are unlikely, through lack of knowledge, to have the same standards of grading as the shippers, and discrepancies owing to this cause in the parcels received by the consumers will lead to trouble. One very important aspect of a mark is that it shall be definite and untampered with, so that any subsequent correction of up-country marking by alteration or cancellation at the port of shipment will give rise to suspicion when the hides reach the buyers, and the system will fail to achieve its purpose. At present the shippers are responsible for grading and compensation for shortcomings, and they cannot be expected to shoulder the obligations arising out of grading which has been done outside their control.

The requirements in detail of a mark placed on a hide or skin are: (1) it must be reasonably easy to apply at the time of preparation under the conditions of the district in question, (2) the letters forming the mark must be permanent to the extent of being clearly

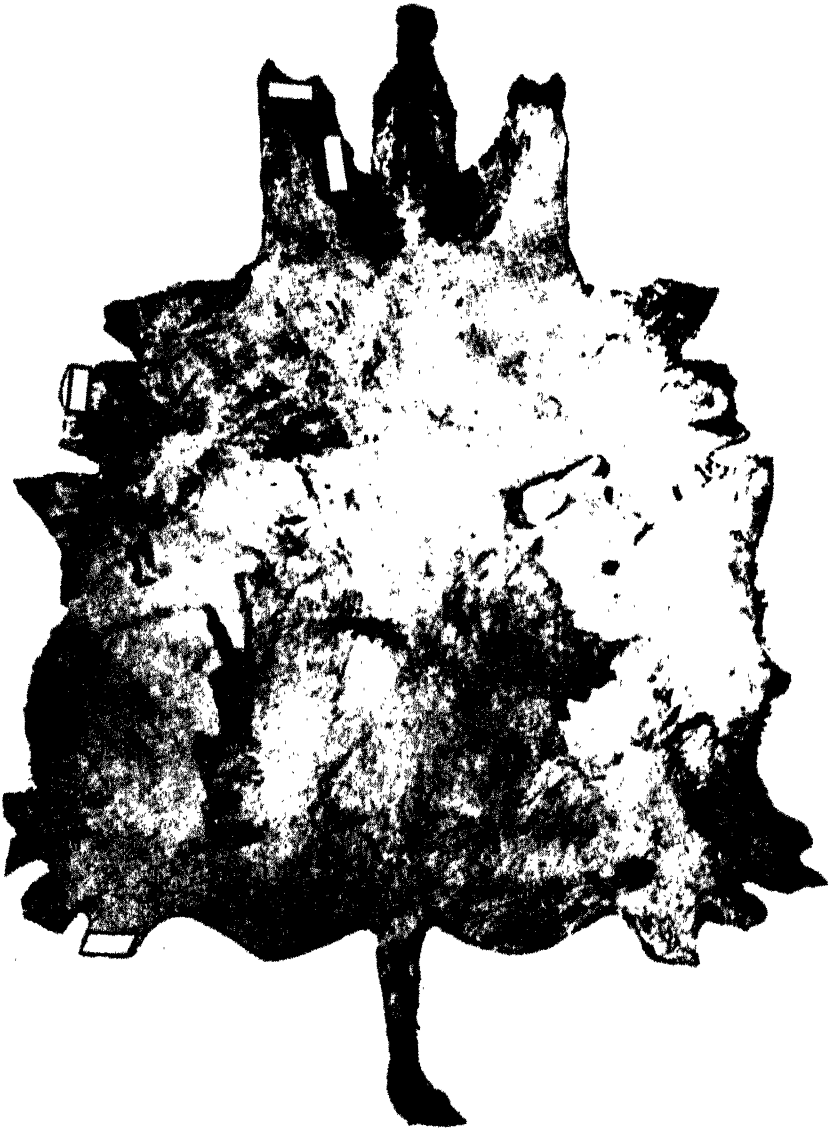
PLATE I.



Hammers and Branding Iron for marking hides and skins

[facing page 10

PLATE II.



Hide showing suitable positions for the mark.

[*facing page* 11

readable when the goods reach the hands of the tanner, and must be capable of surviving re-treatment or arsenication, and (3) the mark must be of such a size, and placed in such a position, that the value of the hide or skin is not impaired.

Marking by means of ink and stencils or rubber stamps is not satisfactory. In the first place such marking is impermanent and very liable to obliteration. Secondly, the surface of the hide is more or less wrinkled and not suited to receive the flat face of a stencil or stamp. Further, the fatty nature of the hide is against the use of ink.

The application of lettering with brush and paint has many disadvantages. The letters must be large to be easily read, and above all it is a method that could easily be used by an unauthorised person.

Adhesive labels are highly unsatisfactory in view of the extreme ease with which they are destroyed or become illegible.

Tie-on discs of plastic material or compressed fibre, while providing a means for carrying a very easily-read mark, are readily detached and interchanged, so that their value as a guarantee is negligible.

Metal discs and the use of wire for attaching labels are to be avoided as they may cause staining, cutting of the hide and trouble to machinery in the tannery, to avoid which extra labour is required to remove them.

The methods which are of practical value and call for consideration are semi-perforation stamping and hot branding.

Dry hides and skins are difficult to mark with an impression or perforation owing to their toughness, although in the green condition such a mark can be easily applied. In general the application of the mark is required on completion of the drying and preparation. In the experiments conducted at the Imperial Institute in conjunction with tanning firms represented on the Committee, dry hides and skins were therefore employed.

The impression or semi-perforation mark can be applied by means of a machine or a hammer fitted with dies. The machine effectively carries out the operation, but it would be expensive for general use, such as in African up-country districts. There are two different types of dies for use in the hammers, and the hammers vary somewhat in design. In the first illustration (Plate I) one hammer, a "spike hammer," is shown with letters (A B C) which are a series of points, while in the other hammer head the letters (B S P) have unbroken lines. Pieces of skin showing the impression made by each type of die are seen in the illustration. The dies are "loose fitters," i.e. each letter is a separate die, and fits into a slot in the hammer. The letters are ⅜ in. high, the size recommended by the Committee after careful consideration.

On a dry hide considerable force is needed in the hammer blow to make an impression, and if too heavy the line-letter hammer is inclined to cut out pieces of the hide, which fall away and leave the letter indistinct. For this reason the spike hammer is preferable.

The use of small circular or triangular holes, applied by hammer, machine, or other device, as a system of identification is open to the objection that such marks are not distinctive, whereas letters can be allotted by common agreement as distinguishing marks for specific countries and districts.

In the tests carried out at the Imperial Institute branding with a hot iron proved to be the easiest method of marking, and the mark was undoubtedly the most-clearly-read one of all those considered. In the illustration a two-letter brand is shown, and the outstanding clearness of the mark in comparison with hammer-made marks is apparent. Moreover, the legibility of the brand mark persists throughout the wet stages in the tannery whereas die impressions are not so easy to read under such conditions. It was found that the best way to apply the brand was to touch the hide lightly with a fairly hot iron, just burning the hide substance. Excessive pressure and great heat should not be applied as this may result in an indistinct burnt patch or hole.

It is considered that a three-letter mark will, in general, be sufficient, and this can be imparted by one brand or hammer, but if it is found necessary to apply four letters it will be found more practical to use two two-letter brands or hammers.

Branding may take longer to apply than hammer stamping, and it has been suggested that the provision of fire for heating the branding iron may be difficult in certain areas, but the advantages of the method make it worth while to incur the additional trouble of providing the necessary material.

Branding is the most satisfactory method of marking cattle hides, for which the spike hammer is not completely suitable. For sheep and goat skins branding may also be employed, but a spike-hammer impression can be successfully applied to these less tough materials, and as it is satisfactory, it will probably be found preferable to use this method for skins.

The position on a hide or skin in which the mark is placed is of great importance, as it is necessary to avoid injuring prime parts. The letters, which are ¾ in. high, should be applied on the flesh side at the top of the neck or cheek, or at the end of the shank, along the edge and close to it. In the second illustration (Plate II) a hide is shown which has been well taken-off, and four positions suitable for the mark are shown. It serves as a guide to the underlying principle of choosing as the marking position a part of the hide most likely to be trimmed off in the tannery, and therefore avoiding damage to material that will form leather. If the head portions have been removed, as is usually the case with Colonial hides, the alternative positions on the shanks may be used.

Under the conditions of necessity existing during the war, Empire hides have entered tanneries where they were unknown or had not been handled for many years. Great satisfaction has been expressed at the improvement achieved in the preparation of certain classes. In the post-war market of unrestricted competition it will be necessary for those hides to maintain this advance in quality, in order to obtain a satisfactory position on the world's markets. To this end certification by marking will be a valuable adjunct to improved preparation.

The plates are from photographs made by Mr. H. J. Broughton of the Imperial Institute.

NOTES

Retirement of Dr. S. E. Chandler, O.B.E., D.Sc., A.R.C.S., F.L.S.—The Institute lost the services of its most senior scientific officer on March 17, 1945, when Dr. Chandler, the head of the Plant and Animal Products Department, retired on reaching the age of 65, after 41 years of service, a period which has included the burden of two world wars and has seen great developments in the work of the Institute.

Chandler was educated at St. Olave's, Southwark, and the Royal College of Science, London, obtaining First Class Honours in Botany in the B.Sc. examination of the London University, of which he became a Doctor of Science in 1905, presenting a thesis *On the Arrangement of the Vascular Strands in the "Seedlings" of Leptosporangiate Ferns.*

From 1902 to 1904 Chandler worked as an assistant in the Department of Botany, British Museum (Natural History), and during the latter year was also Lecturer in Botany at the Birkbeck College. He joined the staff of the Institute in 1904 as Senior Technical Assistant in the Colonial and Indian Collections, receiving promotion to the post of Technical Superintendent in 1909, and taking charge of the Department in 1911.

When that notable development in the organisation of the Institute, the establishment of Technical Advisory Committees, took place in 1916, Chandler was appointed Secretary to the Committee on Timbers, and to the Committee on Silk Production. The results achieved in subsequent years by these Committees are amongst the outstanding successes of the Imperial Institute, and are in no small measure due to the ability of the Secretary and his tireless interest in these subjects.

Chandler also served as Secretary to the Special Committees on Timber and Paper Materials, and on Jute, Cotton, Wool and other Fibres, which were formed under the Indian Trade Enquiry and functioned from 1916 to 1922.

Chandler's wide and accurate knowledge and natural endowments as a teacher found highly successful application as a lecturer. In addition to many public lectures at the Institute and elsewhere on

Empire countries and economic products, he held the post of Instructor in Tropical Agriculture and Products in the African Tropical Service Course which the Colonial Office arranged for Colonial Administrative Officers.

To meet the requirements of the last war a special section, the Technical Information Bureau, was set up, which eventually became known as the Intelligence Section. To this section Chandler was transferred in 1917, to become the head in 1918, a post which he held, latterly with the title of Vice-Principal, until 1936, when he was appointed Principal of the Plant and Animal Products Department, and Secretary to the Advisory Council.

In addition to other scientific papers and articles, Chandler was author of the book *The Useful Timbers of the British Empire* and joint author of *The World's Commercial Products*. He served on numerous committees outside the Institute, including the Cinchona Sub-Committee and the Colonial Housing Research Group, set up by the Colonial Office, and on others formed by the Empire Marketing Board.

He was elected a Fellow of the Linnean Society in 1904, and has served as a member of their Council.

His long work at the Institute was rewarded in 1938 when His Majesty conferred on him the decoration of an Officer of the Order of the British Empire.

Throughout his life he has shown intense interest in military matters, and was associated with the University of London Officers' Training Corps for twenty years. He served as an officer cadet from 1909 to 1912, and in 1914 was gazetted as Second Lieutenant for service with the Corps. He was promoted to the rank of Major in 1926, and resigned in 1931.

During his years at the Institute he visited the West Indies, British Guiana, Newfoundland, Canada, Cyprus and Egypt, and was Rapporteur for the Department of Overseas Trade at the Congrès International du Bois et de la Sylviculture, at Paris in 1931.

In leaving the Institute, Dr. Chandler takes with him the sincerest wishes of the entire staff that he may enjoy many richly-deserved years of recreation and happiness.

The Present Position of Tung Oil Production in the Empire.—In view of the fact that China was the only source of tung oil in 1917, the Imperial Institute instigated cultivation trials in that year with tung trees (*Aleurites fordii*) in a few countries of the Empire, but the results obtained failed to supply much evidence as regards suitable localities for the cultivation of these trees.

In 1928 further efforts to produce tung oil in the Empire were made by Dr. L. A. Jordan, Director of the Paint Research Station, Research Association of British Paint, Colour and Varnish Manufacturers, and also by the Director, Royal Botanic Gardens, Kew, and supplies of Florida tung seed (*A. fordii*) were distributed.

The following year the question was taken up by the Imperial Institute Sub-Committee on Tung Oil, on which body both the above authorities are represented. By means of grants made by the Empire Marketing Board, the Royal Botanic Gardens, Kew, in collaboration with the Imperial Institute Sub-Committee, were enabled to send out during 1929 to 1933, with a view to further cultivation trials, supplies of seed of both varieties of tung trees (*A. fordii* and *A. montana*) of Chinese and Florida origin to many parts of the Empire, where climatic and other conditions appeared suitable.

The results yielded by the series of trials so started were very varied and in many cases disappointing. In a few of the countries the tests showed that tung trees will thrive, and the production of tung oil on a commercial scale has already been started in some of them, namely in Nyasaland, Burma, South Africa and Australia. These industries are still young and are only just being developed.

In the following paragraphs a resumé is given of the present position of tung cultivation in those countries showing the most promise. It must however be pointed out that such progress is not due entirely to the trials instigated by the Imperial Institute Sub-Committee on Tung Oil and to the financial assistance rendered by the Empire Marketing Board, although such encouragement has been a contributory factor. In some countries private enterprise has been responsible for a part of the results. For more detailed accounts of the many trials conducted throughout the Empire reference should be made to articles on " The Experimental Cultivation of Tung Trees in the Empire " in this BULLETIN, 1932, **30**, 24, and " Empire Production of Tung Oil," by L. A. Jordan, in the *Journal of the Royal Society of Arts*, 1935, **83**, 539, as well as to the publication of the International Institute of Agriculture, Rome, entitled " The Tung Oil Trees (*Aleurites*) and the Tung Oil Industry throughout the World " (1938).

Union of South Africa.—In the Union tung cultivation had proceeded so far that in 1939 the South African Tung Growers' Association was formed. It has been estimated that in 1944 there were 130,000 trees in the Union, mostly in Natal and the Transvaal, and in addition about 100,000 in Swaziland. The crop in 1939 yielded 15 tons of oil and in 1943 270 tons. Research work on tung cultivation is being undertaken at the Sub-tropical Horticultural Research Station, Nelspruit, Transvaal. A mill for crushing the seed has been erected at Germiston.

British East Africa.—Cultivation trials have been carried out in several places in Kenya, Tanganyika, Northern Rhodesia and Uganda. The results obtained were reviewed at an Agricultural Research Conference held at Amani in 1936. In Kenya, *A. fordii* was found not to be generally suited while *A. montana* at one place, Sotik, gave promising results. In the Western Province and in the South Highlands of Tanganyika and at Nigoma encouraging results were obtained. In Iringa Province the tests were unsatisfactory. Both in Northern Rhodesia and in Uganda the trials ended in failure.

For the last 10 years or more experiments have been in progress at Amani Experiment Station, mostly at the trial grounds at Kwamkoro. By 1937, 100 acres were under *A. montana* at this station, and in 1940 these trees were reported to be making satisfactory progress. The Imperial Institute is not aware that there exists any tung oil industry in East Africa.

Nyasaland.—Considerable progress has been made in Nyasaland towards the establishment of a tung oil industry. Late in 1940 a Tung Experiment Station was opened at Chisawanu, Cholo, for which purpose a grant was made by the Colonial Development Fund. At this Station a scheme of cultural experiments is now in progress. A Tung Growers' Association was formed in 1938. In 1942 a factory was in operation for the first time, where oil is expressed from the seeds. The original trials and plantations were of *A. fordii*, but of later years *A. montana*, which has been found to thrive better, has become more popular. Most of the plantations are situated in the districts of Cholo, Mlanje, Blantyre and Zomba. The acreage under tung trees in 1943 was 6,847 acres, whereas in 1932 it was only 51 acres. The year in which most increase in acreage was shown was 1939, when 4,401 acres were under this crop. This acreage was over twice that of the previous year. In 1939-40, 35 tons of tung oil were shipped to Australia from Nyasaland.

The Post-War Development Committee, according to its Interim Report No. 4 (August 1944) considers tung offers the best prospects for large-scale development of another permanent crop and hopes at an early date to put forward proposals for assisting development designed firmly to establish this industry as quickly as possible. The Committee understands that the Nyasaland Government is investigating the growing of tung trees by the natives in the Northern Province.

India.—A number of experimental trials have been made in various parts of India, particularly in Assam, Bihar, Bengal, Coorg and Mysore. In the first two districts *A. fordii* has been successfully grown on small acreages, especially on tea estates in Assam. In the other localities mentioned the climatic conditions appear more suitable for *A. montana*. No large-scale commercial undertakings appear to have been started. In the opinion expressed in 1940 by the Industrial Section, Indian Museum, Calcutta, based on a study of the results of the trials carried out in India the possibilities of a tung industry in that country are considerable.

Burma.—Quite promising results have been obtained in Burma. In 1938-39 there were five commercial firms owning estates, where 4,800 acres had been planted. These companies also controlled a further 700 acres owned by the local people. In addition the Forestry Department had assisted Chiefs to plant 750 acres. In the Kengtung State 2,000 acres were under this crop, but it is not expected that more than a very small percentage will yield successful results owing to unsuitable soil and lack of attention. By the end of 1939 it was estimated that 10,000 acres in Burma would have been planted with tung trees, excluding those in Kengtung. During 1938-39, 62 tons of tung seed were exported. On one estate a crushing plant was being installed in 1939.

One of the chief companies operating in Burma is Tung Oil Estates Ltd., with an estate of 5,000 acres. Originally this firm planted *A. fordii* but later, owing to the limited success with that variety, *A. montana* was largely introduced.

As Burma is still largely under enemy occupation more recent information relating to this young industry is not available.

Australia.—New South Wales and Queensland are the two states in the Commonwealth where the most promising results have been obtained. Several companies have been formed to produce tung oil. In Queensland two estates owned by Queensland Forests Ltd. in the districts of Innisfail and Johnstone River have been established for the purpose of demonstrating the possibility of growing the multi-cluster type of *A. fordii* on a commercial scale.

During the years 1937-40 Tung Oil Mills Ltd. distributed in New South Wales 140,000 trees grown from specially selected stock, and it was anticipated that a further 100,000 would be planted by the end of 1940. There were between 500 and 600 growers of tung in New South Wales and Queensland in 1940, with some 250,000 trees planted. In 1939-40, 207 acres were producing seed, and 836 acres had not reached that stage. About 19 tons of oil were prepared.

New Zealand.—This Dominion has been very unfortunate in its experience with the cultivation of tung trees. During 1930-34 about twelve different companies were formed to exploit the production of tung oil. The acreage under this crop was extended rapidly until 1936-37, after which it declined more rapidly until at the beginning of 1942 it was only 29 acres. The following table will indicate the rise and fall of this potential industry.

Year.	Acres.
1931-32 . . .	1,018
1934-35 . . .	4,780
1935-36 . . .	5,057
1936-37 . . .	5,577
1937-38 . . .	3,967
1938-39 . . .	4,403
1939-40 . . .	3,926
January 1942 . .	29

The first trees were planted in 1931 mostly from nursery stock raised from Florida seed. The trees on no estate up to 1936 had grown vigorously enough, or had produced fruit in sufficient quantity, to indicate that a successful industry could be developed. The failure of tung in New Zealand is ascribed by the Soil Survey

Division to the planting of the trees on poor soil and in unsuitable localities. When planting was first started in this Dominion it was thought that, judging from conditions prevailing in those parts of China where tung trees grow, they did not require good soil. In this belief the tung oil companies were started without waiting for the results of experimental plantings. By now the cultivation of tung trees in New Zealand has practically ceased.

G. T. B.

Timbers of French Equatorial Africa.—The knowledge gained during the twenty years previous to the war of the practical qualities of the timbers of tropical Africa, especially West Africa, has been of great assistance in selecting woods suited for service purposes. Many successful applications of the timbers have brought a number of valuable species to increased public notice and have aroused interest in them which will no doubt survive the war. Through the courtesy of M. Georges Monod, of the Mission des Colonies in London, the Imperial Institute has received a copy of a publication entitled *Notice sur les principaux bois de l' Afrique Equatoriale Française*, prepared by the Service des Eaux, Forêts et Chasses and issued by the Government of the Territory, which draws attention to the timber resources of a region which possesses many notable species. In an introduction M. Quint points out that the trees rarely occur in pure stands, and that in consequence it is necessary to make careful selection of species for particular needs. As an aid in such selection the brochure gives a list of the principal timbers of the country comprising only those species likely to be of value to the user and known to occur in sufficient quantity to support a trade in them. The timbers are quoted under their commercial and botanical names, and their respective weights are indicated by figures of mean densities at 15 per cent. moisture. In subsequent sections the timbers are classified according to their recommended uses, e.g. for cabinet work, joinery, general carpentry, plywood, turnery, carving, engraving, waggon and carriage building, rifle stocks, cooperage. The general characters of the classes are briefly indicated, and the density and colour of each timber are stated.

The forested areas concerned lie within the rain forest belt of west and west-central Africa and include the valuable forests of the Gaboon. The timbers mentioned naturally include several familiar as occurring in British West Africa: acajous (mahoganies, from species of Khaya and Entandrophragma), azobe (ekki, *Lophira procera*), bahia (abura, *Mitragyna stipulosa*), iroko (*Chlorophora excelsa*), limbo (afara, *Terminalia superba*), noyers du Gabon (African walnut, *Lovoa klaineana*), movingui (ayan, *Distemonanthus benthamianus*) may be mentioned in this connection. Okoumé (gaboon or gaboon mahogany, *Aucoumea klaineana*) however is almost exclusively a French species, and ozuga (*Saccoglottis gabon-*

ensis), tulipier du Gabon (*Spathodea campanulata*), zingana (*Cynometra* sp.) and several others mentioned as commercial timbers are also typically derived from French sources.

S. E. C.

The Relationship of the Diameter of Derris Roots to the Rotenone Content.—In the commercial exploitation of *Derris* roots one of the questions which had to be decided was whether the whole of the root system should be offered for sale or whether only roots of certain diameters should be marketed. In normal times the roots with a diameter from $\frac{3}{16}$ to $\frac{1}{2}$ in. are preferred in commerce. From the results of histological studies of the plant and of chemical analyses of the roots the conclusion has been drawn that for any one clone the fine rootlets contain relatively little rotenone; small roots (from 2 to 5 mm. in diameter) are generally richest while the rotenone content decreases progressively as the small roots thicken. In making this deduction it must be pointed out that only the diameter of the root is taken into consideration, but not its age, although in the root system of a single plant, roots of the same diameter may not necessarily be of the same age. As a contribution to the evidence in support of this general conclusion a paper entitled "The Relationship of the Diameter of *Derris* Roots to the Rotenone Content" by G. T. Bray, F.R.I.C., Plant and Animal Products Department, Imperial Institute, has recently been published in the *Journal of the Society of Chemical Industry*, 1944, **63**, 384. The author has tabulated therein the results of the chemical examination at the Imperial Institute of a number of samples of Empire-grown *Derris elliptica* roots of varying diameters. Some of these results have already been published in this BULLETIN, 1940, **38**, 153. This additional evidence indicates that usually the thinner roots are richer in rotenone than thick ones, and thereby further supports the opinion generally held. In the case of some samples the very fine rootlets were found to be not as rich as those which were somewhat thicker but which could still be classified as thin roots.

The Effect of Inert Dusts on the Hide Beetle.—Dr. J. A. Kitchener, of the Imperial College of Science and Technology, London, has recently carried out, in collaboration with Dr. J. R. Furlong, of the Imperial Institute, some tests on the efficiency of inert dusts against the hide beetle (*Dermestes vulpinus*). Such dusts, consisting of very finely divided hard mineral powders, have already proved effective as insecticides for use on grain and similar foodstuffs.

In a dry atmosphere the dust exerted a small but appreciable effect on both larvae and adults, but the species proved remarkably resistant to desiccation in comparison with most of the pests occurring on stored products. Tests were also made with the larvae on pieces of hide folded hair side in, under humid conditions. Two pieces were dusted inside and two were left clean as controls, the tests being run at 26° C. and relative humidites of 50 per cent. and 90 per cent. Under these conditions the effect of the dust was not strong enough to produce an appreciable mortality rate, although it acted as a deterrent, the hair side of the treated pieces remaining free from any observable damage. The undusted side of the treated pieces, and both sides of the untreated pieces, were attacked.

It is apparent that the desiccating action of the dusts is not sufficiently strong on these insects under humid conditions, such as those through which hides may travel, for this type of insecticide to be of promise for application to hides and skins.

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Poultry Farming. By J. J. Bronkhorst. *Bull. No. 241, Dep. Agric. Un. S. Afr.* Pp. 72, 9 × 6. (Pretoria: Government Printer, 1943.) Price 1*s*.

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The Growing of Mvule (*Chlorophora excelsa*) in Uganda. By N. V. Brasnett. *E. Afr. Agric. J.*, 1944, **10**, No. 2, 83-89.

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How Best to Utilize the Major Lac Hosts of Central India. By Bhagat Singh Chhabra. *Indian For.*, 1943, **69**, No. 12, 463-467.

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The Effect of Storage on Lac. By M. Rangaswami and S. C. De. *Bull. No.* 56, *Indian Lac. Res. Inst.* Pp. 12, 9½ × 7½. (Ranchi, Bihar: Indian Lac Research Institute, 1944.) Price As. 11.

Reconditioning of Old and Blitzed Lacs. By N. R. Kamath and B. S. Gidvani. *Tech. Pap. No.* 25, *Lond. Shellac Res. Bur.* Pp. 20, 8½ × 5½. (London: Shellac Research Bureau, 1944.)

IMPERIAL INSTITUTE

CONSULTATIVE COMMITTEE ON INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

QUARTERLY BIBLIOGRAPHY OF INSECTICIDE MATERIALS OF VEGETABLE ORIGIN, NO. 29

(October to December 1944)

Compiled by MISS R. M. JOHNSON

With the collaboration of the Imperial Institute of Entomology and the Department of Insecticides and Fungicides, Rothamsted Experimental Station.

GENERAL

Combating the Apple Blossom Borer. By W. Kaiser. *Kranke Pflanze*, 1943, **20**, Nos. 3-4, 22-28. (*Amer. Chem. Absts.*, 1944, **38**, No. 16, 4369.) Pyrethrum, derris and nicotine among the products recommended.

The Small Cold Looper Moth and Means of Combating It. By H. Thiem. *Biol. Reichs. Land- u. Forstw. Flugblatt.*, 1942, **6**, No. 20, 6. (*Amer. Chem. Absts.*, 1944, **38**, No. 16, 4368.) Nicotine, derris and pyrethrum effective against the caterpillars.

Chemicals to Destroy Overwintering Codling Moth Larvae in the Soil at the Base of Apple Trees. By M. A. Yothers and F. W. Carlson. *J. Econ. Ent.*, 1944, **37**, No. 3, 448-450. Pyrethrum and nicotine among the products tested.

Cauliflower and Broccoli Varieties and Culture. By R. C. Thompson. *Frms.' Bull* No. 1957. *U.S. Dep. Agric.*, 1944. In the section on insects and their control rotenone or pyrethrum dusts and sprays are recommended against caterpillars and nicotine against aphids.

Life History and Control of the Caraway Moth. By K. E. Becker. *Mitt. Landw.*, 1943, **58**, 422. (*Amer. Chem. Absts.*, 1944, **38**, No. 21, 6036.) The larvae are controlled with a dust containing derris or sprays containing pyrethrum.

Insects Affecting Guayule with Special Reference to Those Associated with Nursery Plantings in California. By W. H. Lange. *J. Econ. Ent.*, 1944, **37**, No. 3, 302-399. Pyrethrum-lethane dust gives control of the twelve-spotted cucumber beetle and rotenone extracts or combinations of rotenone and pyrethrum extracts satisfactory for leafhoppers.

The Chemical Destruction of Forest Pests. By L. L. Ossowski. *Endeavour*, 1944, **3**, 32-37. (*Amer. Chem. Absts.*, 1944, **38**, No. 16, 4368.) A survey of methods of spraying with various compounds, contact dusts, etc., including veratrine, rotenone and pyrethrum.

The Mirid *Calocoris norvegicus* Gmelin a Strawberry Pest in Nova Scotia. By A. D. Pickett, M. E. Neary and D. MacLeod. *Sci. Agric.*, 1944, **24**, No. 6, 299-303. (*R.A.E.*, 1944, **32**, A, Pt. 9, 298-299.) In the laboratory high kills were obtained with nicotine sulphate, anabasine sulphate or pyrethrum.

Insects Affecting Vegetable Seed Crops in the Western States. By L. G. Smith. *J. Econ. Ent.*, 1944, **37**, No. 3, 362-370. Rotenone, pyrethrum and nicotine among the materials recommended for control.

The Control of the Fir Leaf Wasp (*Diprion pini* L.) in the Netherlands. By J. J. Fransen. *Tijdschr. PlZiekt.*, 1942, **48**, 217-225. (*Amer. Chem. Absts.*, 1944, **38**, No. 17, 4746.) A dusting powder containing 1 per cent. rotenone and a trace of pyrethrum gave the most effective protection.

The Effects of Some Insecticidal and Fungicidal Dusts on Bees. By F. R. Shaw and A. I. Bourne. *Gleanings Bee Cult.*, 1944, **72**, No. 4, 125. (*Exp. Sta. Rec.*, 1944, **91**, No. 4, 451.) Rotenone, pyrethrum and nicotine all caused heavy mortality.

Equipment and Methods Employed in Breeding *Aëdes aegypti* L. for the Biological Assay of Insecticides. By W. A. L. David, P. Bracey and A. Harvey. *Bull. Ento. Res.*, 1944, **35**, Pt. 3, 227-230.

Laboratory Technique for Testing Insecticidal Dusts for Pea Aphid Control. By C. E. Dieter, R. L. Janes, H. F. Wilson and H. L. Burdick. *J. Econ. Ent.*, 1944, **37**, No. 5, 646-651.

A Positive Feeding Device for Application of Dust Mixtures. By T. E. Bronson and J. E. Dudley. *J. Econ. Ent.*, 1944, **37**, No. 4, 538-539.

Wheat Flour as an Adhesive for Sprays. By L. T. Graham, R. M. Sandstedt and H. D. Tate. *J. Econ. Ent.*, 1944, **37**, No. 5, 599-604.

The Outlook for Insecticide Raw Materials. By J. Rodda. *Soap*, 1944, **20**, No. 10, 109-110.

Substitute Insecticides for Fruit Crops and Ornamentals. By R. Hansberry. *J. Econ. Ent.*, 1944, **37**, No. 3, 347-349.

Substitutes for Vegetable Insecticides. By N. F. Howard. *J. Econ. Ent.*, 1944, **37**, No. 3, 345-346.

New Agricultural Crop Insecticides. By H. L. Haller. *J. Econ. Ent.*, 1944, **37**, No. 3, 342-344. Discusses the position with regard to those of plant origin, with special reference to the position in the United States.

Recent Investigations of Insecticides and Repellents for the Armed Forces. By E. F. Knipling and W. E. Dove. *J. Econ. Ent.*, 1944, **37**, No. 4, 477-480. Discusses the use and limitations of rotenone and pyrethrum.

Insecticidal Aerosols. By L. D. Goodhue. *J. Econ. Ent.*, 1944, **37**, No. 3, 338-341.

Intimate Blending of Dust Insecticides. By T. B. Dorris. *Soap*, 1944, **20**, No. 11, 111-117.

New Insecticides Aid the War Effort. By R. C. Roark. *Chem. Engng. News., News Ed.*, 1944, **22**, No. 17, 1464-1469. Includes an account of compounds of vegetable origin.

Insecticide. U.S. Pat. No. 2,346,256. (*Amer. Chem. Absts.*, 1944, **38**, No. 18, 5041.) Insecticidal composition is made of rotenone or pyrethrin or both with a phenol of the *Anacardiaceae* family as solvent. The mixture is emulsified.

ALKALOID-CONTAINING MATERIALS

Tobacco Products, including Nicotine and Nicotine Derivatives

Citrus Research in Southern Rhodesia. By W. J. Hall. *Ann. Appl. Biol.*, 1944, **31**, No. 2, 164-165. Nicotine spray found useful in the control of citrus aphis.

Control of Citrus Thrips. Resistance to Tartar Emetic Sprays forces Development of New Methods. By C. O. Persing and L. R. Brown. *Citrus Leaves*, 1944, **24**, No. 3, 7, 14-16. (*Amer. Chem. Absts.*, 1944, **38**, No. 16, 4367-4368). Nicotine materials offer promise with best results obtained with nicotine sulphate.

The Pea Leaf-miner, *Phytomyza atricornis* (Meigen) in India. By Taskhir Admad and R. L. Gupta. *Indian J. Ent.*, 1941, Pt. 1, 37-49. (*R. A. E.*, 1944, **32**, A, Pt. 11, 394.) Spraying with nicotine sulphate and soft soap in water gives effective control.

Mealy Bugs on Vines. By C. J. Joubert. *Bull. No.* 243, *Dep. Agric. Un. S. Afr.*, 1943. (*R. A. E.*, 1944, **32**, A, Pt. 11, 356.) Isolated infestations may be effectively treated with nicotine sulphate spray.

A Study made in 1941 on Means to be used for the Control of Yellowing of Sugar Beets. By L. Decoux, G. Roland, R. Wanthy and L. Claerhout. *Publ. Inst. Belge. Amélioration Betterave*, 1942, **10**, 57-92. (*Amer. Chem. Absts.*, 1944, **38**, No. 16, 4371.) The yellowing is caused by leaf lice and the use of tobacco or nicotine liquors is suggested.

The Use of Oleic Acid and Aluminium Sulfate to Increase Deposits of Nicotine Bentonite. By C. C. Alexander, C. C. Cassil, F. P. Dean and E. J. Newcomer. *J. Econ. Ent.*, 1944, **37**, No. 5, 610-617.

Control of the Pecan Nut Casebearer with Lead Arsenate, Nicotine Sulfate and Summer Oil. By C. B. Nickels and W. C. Pierce. *J. Econ. Ent.*, 1944, **37**, No. 4, 510-512.

Farm Stock Insecticides. By J. A. Munro. *J. Econ. Ent.*, 1944, **37**, No. 3, 350-351. Mentions the value of nicotine for replacing rotenone and pyrethrum.

Chicken Louse Control. By H. S. Telford. *Soap*, 1944, **20**, No. 8, 113. DDT, nicotine and pyrophyllite used.

Worms in Sheep. By S. A. Mountjoy. *J. Dep. Agric. Vict.*, 1944, **42**, Pt. 8, 343-348. A combination of copper sulphate and nicotine sulphate recommended for the control of certain worms.

The Nicotine Content of Hungarian Tobaccos. By K. Gärtner. *Tabak*, 1940, **2**, 500-501. (*Amer. Chem. Absts.*, 1944, **38**, No. 17, 4756.)

Nicotine in Rumanian Tobacco. By I. D. Vladescu and I. Zaporojanu. *Tabak*, 1940, **2**, 593-598. (*Amer. Chem. Absts.*, 1944, **38**, No. 17, 4755.) Less than 1 per cent. in most cases in numerous samples of Molorata type leaf.

The Alkaloids of *Lycopodium* species. VI. *Lycopodium clavatum* L. By L. Marion and R. H. F. Manske. *Canad. J. Res.*, 1944, **22**, Sec. B, No. 5, 137-139. A small amount of nicotine was isolated in specimens of American origin.

Insecticides such as those for combating beetles and weevils. U.S. Pat. No. 2,353,442. *Amer. Chem. Absts.*, 1944, **38,** No. 21, 6040. A carrier such as a powder or liquid is used with an admixture of a small proportion of N-isoamyl-hexahydronicotine or N, N-diisoamyl-hexahydroanabasine or other specified tertiary amine.

Anabasine

The Use of Anabasine Sulphate (Aerosol) in the Control of Mosquitos (*Anopheles maculipennis*). *Med. Parasitol.*, 1942, **11,** No. 5, 48-50. (*R. A. E.*, 1944, **32,** B, Pt. 9, 166.)

INSECTICIDE MATERIALS CONTAINING ROTENONE AND ALLIED SUBSTANCES

General

Parasite Control Material, suitable for Combating the Red Spider and other pests. U.S. Pat. No. 2,350,328. (*Amer. Chem. Absts.*, 1944, **38,** No. 18, 5042.) A product made by stirring rotenone or other fish poison into molten sulphur.

Summer Sprays for the European Red Mite. By J. A. Cox. *Virginia Fruit*, 1944, **32,** No. 2, 14, 16-18. (*Amer. Chem. Absts.*, 1944, **38,** No. 16, 4370.) Ground derris-oil spray or rotenone bearing insecticides gave satisfactory control on apple trees.

The Pear Thrips in California. By S. F. Bailey. *Bull. No.* 687, *California Exp. Sta.*, 1944. (*Exp. Sta. Rec.*, 1944, **91,** No. 4, 445.) Of all the proprietary spray materials tested rotenone has given outstanding results.

Potato Production in the Northeastern and North Central States. By P. M. Lombard and B. E. Brown. *Frms.' Bull. No.* 1958, *U.S. Dep. Agric.*, 1944. In the section on insect enemies of the potato reference is made to the use of rotenone in controlling the Colorado beetle and aphids.

Dispersants for Rotenone. A Study of the Effect of Dispersants on the Toxicity of Rotenone Dusts. By E. J. Campau and H. F. Wilson. *Soap*, 1944, **20,** No. 10, 117-121.

Control of the Pickleworm on Squash and Cucumber. *J. Econ. Ent.*, 1944, **37,** No. 4, 534-536. Rotenone dust gave some control.

Rotenone for Tick Control. *Soap*, 1944, **20,** No. 10, 129. Rotenone made available in U.S.A. in small quantities in tick-infested areas where human life is endangered.

Strength of Rotenone Dust Mixtures and Rate of Application in Pea Aphid Control. By J. E. Dudley and T. E. Bronsen. *J. Econ. Ent.*, 1944, **37,** No. 5, 643-646.

Plants that are Poisonous to Fish : Venezuelan Species. Pharmacology of Rotenone. By J. M. Bianca. *Gaceta Farm.*, 1943, **3,** No. 20, 22-40. (*Amer. Chem. Absts.*, 1944, **38,** No. 6, 1324.)

Derris

Oil Sprays with or without Derris Resins to Control Florida Red Scale. By M. S. Osburn and W. Mathis. *J. Econ. Ent.*, 1944, **37,** No. 4, 516-519.

Toxicity of Extracts of Derris Root for Mice. By H. B. Haag, I. Taliaferre and L. D. Goodhue. *Proc. Soc. Exptl. Biol. Med.*, 1943, **54,** 140-141. (*Amer. Chem. Absts.*, 1944, **38,** No. 3, 581.)

Mystery Insecticide Studies. Remarkable Results Obtained in DDT Experiments on Red Scale. By D. L. Lindgren, J. P. LaDue and D. Dow. *Citrus Leaves*, 1944, **24,** No. 4, 6-7, 30. (*Amer. Chem. Absts.*, 1944, **38,** No. 16, 4370.) A spray combination of ground derris root, DDT and kerosene gave a high initial kill as well as a pronounced residual effect.

Rep. Dep. Agric. Trinidad for 1943, p. 13. In an experiment on the control of *Hellula phidilealis*, a pest of cabbages and cauliflowers, lead arsenate gave better control than a proprietary derris compound.

Cube

Lonchocarpus Root (Cube or Timbo), a Valuable Insecticide from the Amazon Region, compared with Derris Root from South-east Asia. By C. van Koppel. *Landbouwkund. Tijdschr.*, 1943, **55**, 31-44. (*Amer. Chem. Absts.*, 1944, **38**, No. 16, 4372.)

The Effect of Plant Dispersants on the Toxicity of Rotenone in Ground Cube when used for Pea Aphid Control. By H. F. Wilson, E. J. Campau and R. L. Janes. *Soap*, 1944, **20**, No. 10, 121.

Others

Recent Work on Agricultural Chemistry in China. By Shui-Lwen Hwang and Sing-Chen Chang. *Acta Brevia Sinensia*, 1943, No. 4. (*R.A.E.*, 1944, **32**, A, Pt. 9, 290-291.) Refers to the control of *Aphis gossypii* by cotton seed oil emulsion: the rotenone content of derris introduced into Kwangsi and the seeds of *Pachyrrhizus erosus* and *Millettia pachycarpa*.

PYRETHRIN-CONTAINING MATERIALS

The Use of Repellents Against Fleas. By A. W. Lindquist, A. H. Madden and C. N. Watts. *J. Econ. Ent.*, 1944, **37**, No. 4, 485-486. Among a number of compounds tested the most satisfactory was a pyrethrum preparation containing a small quantity of a proprietary material.

Comparative Toxicity under Barn Conditions of Livestock Type Fly Sprays made from Various Combinations of Toxic Ingredients and Base Oils. By F. W. Atkeson, R. C. Smith, A. R. Bergmann and H. C. Fryer. *J. Econ. Ent.*, 1944, **37**, No. 3, 428-435. Pyrethrum among the materials used in the experiments.

The Repellency of a Pyrethrum-Thiocyanate Oil Spray to Flies Attacking Cattle. By D. E. Howell and F. A. Fenton. *J. Econ. Ent.*, 1944, **37**, No. 5, 677-680.

Repellency of Pyrethrum Extract and Other Materials to Full-Grown Codling Moth Larvae. By M. A. Yothers and F. W. Carlson. *J. Econ. Ent.*, 1944, **37**, No. 5, 617-620.

Repellents for Sandfly Fever Vector. By A. B. Sabin et al. *J. Amer. Med. Assoc.*, 1944, **125**, 603-693. Dimethyl phthalate and a vanishing cream containing pyrethrum applied to the skin were found to be effective repellents for *Phlebotomus papatasi*. (Abst. in *Mfg. Chem.*, 1944, **15**, No. 11, 399.)

Control of Head and Pubic Lice. By D. N. Roy and S. M. Ghosh. *Bull. Ento. Res.*, 1944, **35**, Pt. 3, 231-234. Pyrethrum can be successfully employed.

Tests with Synergists for Pyrethrum Against the Body Louse. By R. C. Bushland, G. W. Eddy and E. F. Knipling. *J. Econ. Ent.*, 1944, **37**, No. 4, 556-557.

Pyrethrum Marc for Control of Fall Cankerworm and Tussock Moth. By A. D. Borden and L. R. Jepson. *J. Econ. Ent.*, 1944, **37**, No. 4, 562.

Electrostatic Charge Effects Produced by Insecticidal Dusts. By H. F. Wilson, R. J. Janes and E. J. Campau. *J. Econ. Ent.*, 1944, **37**, No. 5, 651-655. A proprietary pyrethrum dust among the materials tested.

Determination of Freon-Insoluble Solids in Twenty Per cent. Pyrethrum Extracts. By H. Wachs, C. Morriello and S. Mages. *Industr. Engng. Chem., Anal. Ed.*, 1944, **16**, No. 7, 453-454.

Report on Insecticides. Factor for Pyrethrin I Determination. By J. J. T. Graham. *J. Assoc. Off. Agric. Chem.*, 1944, **27**, 548.

Synergists to Aerosol Insecticides. U.S. Pats. Nos. 2,345,891–2,345,909 of 1944. *Amer. Chem. Absts.*, 1944, **38,** No. 17, 4,748.

U.S. Aerosol Bomb. *Soap*, 1944, **20,** No. 10, 127. Brief reference to report that DDT is to be included which will allow for a reduction in the pyrethrin content.

Pyrethrum [in Australia]. *Ann. Rep. Coun. Sci. Industr. Res. Australia*, 1943. Brief reference to the experimental plot at Canberra.

Pyrethrum Production, Ceylon. *Emp. Producer*, 1944, No. 284, 32. Production sufficient to meet the requirements of the Medical Department.

Cyprus Producing Pyrethrum. *Chem. Age*, 1944, **51,** No. 1318, 330. Brief note only.

Ann. Rep. Imp. Coun. Agric. Res. India, 1942-43, p. 6. Pyrethrum to be produced in Madras, Punjab, Assam and Kashmir to meet the requirements of the Defence Services in India.

Coffee Conference, Kenya. *Mthly. Bull. Coffee Brd., Kenya*, 1944, **9,** No. 103, 83. Release of pyrethrum requested for dealing with antestia and capsid bugs.

Pyrethrum in Nyasaland. *Interim Report No. 4, Post-War Development Committee, Nyasaland.* Recommendation of the Committee regarding pyrethrum growing, p. 1.

Pyrethrum Drying. By V. A. Beckley and F. McNaughton. *Rhod. Agric. J.*, 1944, **41,** No. 5, 313-324.

Parasiticide. Brit. Pat. No. 552,879. *Soap*, 1944, **20,** No. 10, 125. Essentially a spray of mannitan coconut oil derivative with the addition of pyrethrum.

Insecticide. U.S. Pat. No. 2,358,392. *Soap*, 1944, **20,** No. 11, 73. A method of purifying pyrethrum extract.

Pyrethrum roseum, a Spanish Insect Control Means. By F. Obdulio and C. Capdevila. *Farm. Nueva*, 1943, **8,** 332-342, 395-400. (*Amer. Chem. Absts.*, 1944, **37,** No. 21, 6037.)

OTHER INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

Air kak insektitsidnoe i otpugivayvshchee sredstvo. [Sweet Flag (*Acorus calamus*) as an Insecticide and Repellent.]. By V. S. Mironov. *Med. Parazitol., Moscow*, 1940, **9,** 409-410. (*Vet. Bull.*, 1944, **14,** No. 8, 286.) Powdered roots were found toxic to *Anopheles* mosquitoes and house flies: repellent for ticks.

Preliminary Report on Mosquito Repellents. By E. Richman and H. O. Deay. *Proc. Indian Acad. Sci.*, 1942, **52,** 192-195. (*R.A.E.*, 1944, **32,** B, Pt. 11, 210-211.) Mixture of cedar wood oil, citronella oil and spirits of camphor satisfactory.

Cottonseed Tar as a [Mosquito] Larvicide in East Africa. By G. H. E. Hopkins. *E. Afr. Med. J.*, 1943, 20. (*Pharm. Absts., U.S.A.*, 1944, **10,** No. 10, 319, in *J. Amer. Pharm. Assoc., Sci. Ed.*, **33,** No. 10.)

Toxicity to Flies of Derivatives of Eugenol and Cis- and Trans-Isoeugenol. By T. F. West. *Nature*, 1944, **154,** No. 3911, 488.

Toxicity of Ricin, Ricinine and related Compounds to Codling Moth Larvae. By E. H. Siegler, M. S. Schechter and H. L. Haller. *J. Econ. Ent.*, 1944, **37,** No. 3, 416-418. Ricin and ricinine occur in the castor bean plant.

Sabadilla, *Schoenocaulon* spp. with reference to its Toxicity to Houseflies. By T. C. Allen, R. J. Dicke and H. H. Harris. *J. Econ. Ent.*, 1944, **37,** No. 3, 400-408.

Sabadilla Lice Tests Favorable. *Soap*, 1944, **20,** No. 11, 129. Sabadilla found to be nearly as effective as rotenone in controlling cattle lice.

BOOK REVIEWS

Books for review should be addressed to "The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

BRITISH WOODLAND TREES. By H. L. Edlin, B.Sc., Pp. ix + 182, 8½ × 5½. (London: B. T. Batsford, Ltd., 1944.) Price 12s. 6d.

This excellent book has three outstanding features which will secure for it a wide circle of readers: a fine series of full-page photographs of trees in their natural surroundings; some 30 plates of tree foliage, flowers and fruits reproduced by reduction from John Evelyn's "Silva," which for most people will provide their only opportunity of acquaintance with that famous work; and a descriptive text which will attract by its satisfying information conveyed with a minimum of technical terms. There are also many line drawings illustrating botanical features, and a reproduction of John Crome's "Poringland Oak" forms a coloured frontispiece.

The author intends the book for the use of foresters and students of forestry and as a handbook for the many laymen interested in the trees of the countryside. Two hundred species included in 57 genera are dealt with in two main sections devoted, respectively, to broad-leaved trees and conifers and embracing every species grown commercially in British woodlands as well as all indigenous trees and many others grown for ornamental purposes. The method adopted is to devote separate chapters to the simpler species, e.g. birch, ash, alder, sweet chestnut, while the more difficult groups are described in others dealing with "the poplars," "the willows," "the pines," "the larches," etc. In each case the tree at all seasons of the year and in its seedling and later stages is carefully described, with details of the varying methods employed in forest planting and the subsequent sylvicultural treatment to produce a commercial plantation. The characters and uses of the resulting timber are also described. A feature of much practical value is a series of reference lists of light-demanding trees, shade-tolerant species, trees for towns, seaside, gardens and hedges; and of timbers for firewoods and for durability purposes. Two appendixes provide useful keys to the identification of broad-leaved trees and conifers respectively.

S. E. C.

SOYBEAN CHEMISTRY AND TECHNOLOGY. By Klare S. Markley and Warren H. Goss. Pp. vii + 261, 8½ × 5½. (New York: Chemical Publishing Company, Inc., 1944.) Price $3.50.

During the last twenty years the soya bean has become a very important crop in the United States of America, the quantities produced having shown an enormous increase from 5 million bushels in 1924 to 209 million bushels in 1943. During the present war the crop has been doubled. Soya beans owe their importance to the many uses to which they and their products are put. It is only natural therefore that considerable research work has been undertaken to determine the chemical composition of these beans and of their products. The results of these investigations have been assembled in the first half of this book.

After dealing with the chemical composition of soya beans, the constituents and their properties are reviewed seriatim. Considerable attention is given to the nature and amount of the vitamins present in the beans, an all-important question according to modern thought. Soya bean oil, to which the beans owe most of their commercial importance, is dealt with in some detail, particulars being given of its physical and chemical characteristics and of the glycerides and sterols and other minor constituents. Soya beans contain antioxygenic bodies, and the nature of these substances is discussed in another section. As regards the phosphatides present in soya beans, details are given of the various ways in which these constituents are utilised.

The second part of the book is confined to a treatise on the processing of soya beans. The earlier pages are devoted to outlining the development of this industry in the United States from its inception in 1915 and the building up of a market for the meal or cake as a protein feed, a market which had become firmly established by 1930. Details are given of the grading of the beans and of the methods of drying and storage. The various methods practised for the manufacture of the oil are described. Regarding the three methods in use for this purpose, 74 per cent. of the 1940-41 crop was treated in expellers, 23 per cent. by solvent extraction, and the remainder in hydraulic presses. Eight different makes of expellers are in operation. The continuous process of solvent extraction is the one more favoured. Lists are included of the manufacturers in the United States of America of suitable plant and of the mills processing soya beans. Further information is given regarding the methods in vogue for refining the oil for edible purposes. The processes employed for the production and refining of phosphatides are described. These are based on German methods, that of Bollmann being generally preferred.

The book contains a mass of useful information collected together from many papers and articles which have been published on the subject of the composition and constituents of soya beans and their processing. References to over 700 are given in the bibliography. The book is well printed and is illustrated with a number of intertextual plates. It should prove of interest and value to all those who are concerned with soya beans and their products either from a chemical or an industrial point of view.

No reference is made in the book to the fact that its contents, with slight exceptions, originally appeared in 1942 in a mimeographed publication of the Bureau of Agricultural Chemistry and Engineering, United States Department of Agriculture (ACE-142, Parts I and II).

G. T. B.

Fats and Oils in the War. By Karl Brandt. War-Peace Pamphlets, No. 2. Pp. 60, 9 × 6. (California: Food Research Institute, Stanford University, 1943.) Price 25 cents.

The author of this pamphlet had as his object in writing it a presentation of the war-time position of the supply of oils and fats for human consumption in the chief countries most seriously affected by the war. When considering this question invisible fats, consumed as an integral part of some food such as meat, eggs, milk or fish, were included as well as visible fats, for instance, butter, margarine and lard. After a short explanation of the properties and uses of oils and fats, the next few pages are devoted to production, trade and consumption. The main portion of the pamphlet describes war-time supplies and adjustment plans. It is worthy of note that only Great Britain and Germany took steps prior to September 1939 to build up reserve stocks of fats against the eventuality of war. Each country is reviewed separately. The pre-war sources of supply are detailed, the war-time sources enumerated, and the methods taken to ensure quantities adequate to maintain good health are described. A table is given showing the rations of visible fats prevailing in the different countries. The statement is made that Great Britain is at least as well off as Germany when both visible and invisible fats are considered together. The author concludes that, in his opinion, there are not likely to be any catastrophic shortages of fats during this war except as a result of large scale invasion, ensuing evacuation and abandoning of farms.

The pamphlet contains a mass of information and is a useful contribution to the study of the effect of hostilities on the supply of fats to countries seriously affected by the war.

G. T. B.

The Food Resources of Africa. By Thomas S. Githens and Carroll E. Wood, Jr. *African Handbooks*: *No.* 3, Pp. 105, 8¼ × 5½. (Philadelphia: University of Pennsylvania Press; London: Oxford University Press, 1943.) Price 9*s.* 6*d.*

The scope of this book is confined to Tropical and North Africa. The Union of South Africa, Southern Rhodesia, Egypt and Mozambique are not considered. In the first four chapters Mr. Githens deals with West Africa (British West, French West and Equatorial, Liberia), and rather more briefly with West Equatorial Africa (Belgian Congo, Angola), North East Africa (Sudan, Abyssinia, Somaliland), and East Africa (Kenya, Uganda, Tanganyika, Nyasaland, Northern Rhodesia). Mr. Wood provides a fifth chapter devoted to French North Africa, which is perhaps the most successful section of what seems altogether a rather unsatisfactory work.

The subject embraced in the title is formidable for a book of this length, and much of the matter receives somewhat superficial treatment. For instance, the important question of livestock and livestock products is given little more than passing attention. An unfortunate feature of the introductory pages is that the "primitiveness" of African farming has been overdrawn. In places the general picture given the reader seems to verge on the ridiculous. A more careful appreciation of African methods and circumstances is required than is provided here.

In the West African section the statistical tables contain many figures which are of doubtful value, and may be misleading if quoted apart from the text and the author's reservations. This chapter also contains several technical mistakes, due, it would appear, mainly to the misreading of authorities consulted. For instance, the question of the amounts of hydrocyanic acid yielded by "bitter" and "sweet" varieties of cassava. The sweet orange is not a recent introduction; excellent fruit is produced in several areas, though it may not be of full export quality. Other errors occur in respect of oil palm varieties, and the local utilisation of kola.

E. H. G. S.

SCIENCE AND SALVAGE. From the German "Verwertung des Wertlosen," edited by Claus Ungewitter. Translated by L. A. Ferney and G. Haim. Pp. 183, 8½ × 5½. (London: Crosby Lockwood & Son, Ltd., 1944.) Price 12s. 6d.

The word "salvage" is associated at the present time with the saving of domestic waste as a contribution to the national effort. This book deals with the question not merely from the point of view of the "kitchen front," but from that of a front comprising field, forest and factory, mines and municipalities, the atmosphere and the ocean. It is a slightly condensed translation of *Verwertung des Wertlosen*, which was published in Germany before the present war and was reviewed in this BULLETIN, 1939, **37**, 82. The subject matter has not been altered to adapt it to special conditions in Britain, but the importance of the subject to this country is forcefully brought out in the introduction contributed by Dr. E. Frankland Armstrong. Indeed, the problems considered, their economic aspects, and the ways in which science can deal with them, have a relevance that is common to all countries where there are mining, manufacturing and agricultural industries, and their handling will form a very important factor in the economic rebuilding of the nations.

F. F.

CHEMICAL INDUSTRIES. Edited by L. Ivanovszky. Nineteenth Edition. Pp. xxviii + 392, 11 × 8½. (London: Leonard Hill Limited, 1944.) Price 15s.

Since the eleventh edition of this book was reviewed in this BULLETIN (1936, **34**, 566) fresh editions have been published each year, and it may be stated with confidence that in spite of wartime production difficulties and paper restrictions, progressive improvement has been achieved. Extensively revised in 1943, with the addition of new features, the publication has now been further revised and enlarged, and the ten sections into which it is still divided deal with various aspects of chemical manufacture and plant construction. These include constructional materials, power plant and chemical plant, glossaries of industrial and fine chemicals, and chemical and physical tables furnishing data relating to organic and inorganic compounds.

Chemical Industries contains a very large amount of detailed information, extremely useful to chemists, chemical engineers, and other technicians concerned in the manufacture or utilisation of chemicals.

H. T. I.

MINERAL RESOURCES

ARTICLE

THE MINING GEOLOGY OF THE IRAMBA-SEKENKE GOLDFIELD, TANGANYIKA TERRITORY

By R. B. McConnell, D.Ph., D.Sc., F.G.S.
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The Iramba Goldfield is the oldest known of the gold producing areas of Tanganyika. Sekenke mine itself was extensively worked during the period of German occupation. Kirondatal mine is even older, for its native name of *Misigiri*, meaning " the place of money," suggests that gold was won from the surface outcrops before the coming of the white man. It is probable that the Arabs were responsible for this early exploitation.

The present report is a summary of the results arrived at during field work carried out by the writer between October 1939 and March 1940. The areas of economic importance were studied in detail and large-scale maps of all the principal mines were prepared.

Geographical Situation and Communications

The goldfield is situated in the Central Province of Tanganyika Territory and lies 150 miles to the south-east of Lake Victoria, and 120 miles north of the Central Railway: the township of Singida is the nearest centre of importance. Part of the goldfield is on the Iramba Plateau, a horst-block bounded by fault scarps on the west, north and east; but Sekenke mine, the most important in the area, is in the low-lying Wembere Plains, which drain into the closed basin of Lake Eyasi. The altitude of the Iramba Plateau is about 5,000 ft., whereas Sekenke mine is 3,500 ft. above sea-level.

Access to the area is made easy by a branch line which leaves the Central Railway at Manyoni and, passing through Singida, terminates at Kinyangiri, 90 miles north of Manyoni. From Kinyangiri railway station an all-weather road, about 50 miles in length, runs westwards through the centre of the area to Sekenke, the most westerly of the mines. There are all-weather landing grounds at Singida and at Kisaga, on the Iramba Plateau, whence the mines are easily accessible at all seasons by road. The landing ground at Sekenke is closed during the rains. Between July and October the area can usually be reached by road from Tabora on the Central Railway, and also from Shinyanga on the Mwanza branch line.

The geology of the Iramba Plateau and Singida area has been thoroughly described by Eades and Reeve (*Bull. No.* 11, *Geol. Div., Tanganyika Terr. Dept. of Lands and Mines*, 1938).

GEOLOGICAL SETTING

The area lies on the north-east margin of the great central granite massif of Tanganyika and, with the exception of some superficial deposits, the rocks are all of pre-Cambrian age. They consist in the main of a greenstone-volcanic series and a sedimentary series, both of which have undergone metamorphism and belong to the Upper Basement Complex. These rocks are intruded by a porphyritic microcline-granite, which commonly exhibits hybridization phenomena at its borders. In the vicinity of Sekenke, a band of quartz-diorite separates the granite from the greenstone-volcanics.

The volcanic series, as described by Eades and Reeve, consists mainly of altered basalts and chloritized and epidotized dolerites; some of the latter form bands sufficiently hard and tough to make mining difficult. By contrast with the Lower Basement Complex, no garnet, kyanite or other deep-zone metamorphic minerals are found. The greenstone-volcanics occur in the western and central portions of the area; in the east is a meta-sedimentary series consisting mainly of semi-pelitic mica-schists with intercalated quartzite bands. The majority of the gold deposits lie in the volcanic series near the granite contacts, but some prospects and one producing mine are found in the schists. A number of dykes, both acidic and basic, are found in the vicinity of the mines. The basic dykes are without exception dolerites, although Eades and Reeve describe lamprophyres from the area.

The Iramba-Sekenke area has been much faulted and sheared, and, while the scarps of the Iramba Plateau are due to faults of Rift Valley age, the main tectonic movements are believed to have taken place at a much earlier date. Investigation has shown that all the important gold deposits have been formed in connection with well-marked zones of shear. The principal directions of shearing are (1) N.E.—S.W., (2) N.W.—S.E. varying to N.N.W.—S.S.E., (3) N.—S. varying to N.N.E.—S.S.W., and (4) E.—W. varying to E.S.E.—W.N.W. It will be noticed that these directions fall into two complementary systems of shearing, numbers (1) and (2), and numbers (3) and (4) being respectively at right angles to each other. The strike of the greenstone-volcanics is generally either N.W.—S.E., E.—W., or N.—S. varying to N.N.E.—S.S.W. The quartz veins of Sekenke and the adjacent mines are developed in shears conforming to group (2), while those reefs of most value on the plateau conform to direction (3). In the meta-sedimentary area the lodes of Kinyalele mine trend N.E.—S.W.

THE GOLD DEPOSITS

Types of Deposits.

The gold deposits of the Iramba-Sekenke area fall into two categories: (1) quartz veins of mesothermal type and (2) impregnation deposits. By far the larger proportion of the gold produced in the area is won from quartz veins in the greenstone-schists or diorites and on only one producing mine (Kinyalele) is an impregnation deposit being worked.

The gold in the quartz veins is often free milling, but may be 'locked' in pyrite or arsenopyrite. The quartz is generally mineralized to some degree, and the most common minerals are the sulphides, of which pyrite is often abundant. Arsenopyrite is present in some mines and may carry refractory or 'locked' gold, while pyrrhotite occurs in a few cases and appears to be always barren. Chalcopyrite occurs to some extent and zinc blende is rare. Other minerals found in the veins are tourmaline, calcite and ankerite.

Shear Zones.

The gold-bearing quartz veins may themselves be divided into two groups: (1) those which follow definite lines of shear, and (2) those which are parallel to the planes of schistosity and belong to the 'lenticular' type of quartz vein. The producing mines all belong to the first group, and those of the second have always proved disappointing both as regards continuity of width and of persistence of gold values in depth. The shear zones are narrow, ranging from 1 or 2 ft. in width (as in certain mines on the plateau) to 6 or 8 ft. at Sekenke. They are constant in direction, and, although not always mineralized, may be followed on the surface for considerable distances. It is believed that these shears have served as channels for the mineralizing solutions, and, therefore, where ore-shoots exist in them, gold values may continue to a considerable depth. The shears are usually nearly vertical; they are sometimes parallel to the direction of the country rock (e.g. Sekenke, Kirondatal), elsewhere they cross the schists at an angle (e.g. Escarpment and McCallum's).

Although it is certain that the shearing has taken place at widely different times, its age is not known. In the description of Kirondatal and Sekenke mines, evidence will be given to show that the shears followed by the quartz veins were in existence before the intrusion of the latest granite. Since their formation, the shears have moved again and again, and have shattered dykes and quartz veins that had formed in them. Examination of the grooving of a large number of slickensides shows that the movement of most of the faults was mainly horizontal and of the nature of a tear-fault or *décrochement;* there is evidence that compression accompanied the faulting. The rifting that produced the escarpments of the Iramba Plateau is parallel to some of the older shearing, and it is thus probable that it is due to some form of revival of the older movements. In the deep gorge cut by the Kironda River in the western edge of the Iramba Plateau a fault was seen that appeared to be related to the recent rifting. It was parallel to the scarp (i.e. N.N.E.), vertical, and filled with a coarse fault-breccia indicative of movement near the surface of the earth's crust.

Surface Enrichment.

A remarkable degree of surface enrichment is characteristic of the area, and all the veins now being worked in depth carried at the surface values ranging upwards of 1 oz. of gold per ton. Similarly, veins that carried good workable values on the surface (e.g. 7 to 15 dwt.) were commonly found to lose value and become unworkable at depths sometimes as shallow as 15 ft. or less. It may be said that veins which do not follow a definite shear zone generally lose value in depth. Dendrites of manganese dioxide are commonly found in the quartz veins of the gold-bearing area.

Albitization and Albitophyre Dykes.

Metasomatic alteration is a characteristic of some of the most valuable deposits of the goldfield, and, in the western area, generally takes the form of albitization. Good examples of albitization are found in the Sekenke and Kirondatal mines, and will be described in later paragraphs. The metasomatic albite is very sodic and has the composition $Ab_{95}An_5$. A notable feature is that the albitization of the vein fissure was preceded by the injection of dykes of albitophyre carrying phenocrysts of albite with a similarly sodic composition. The sodic alaskite described by Gallagher (*Economic Geology*, 1939, **34**, No. 3, 243-267) from the Lupa goldfields is recalled, and it is interesting to note that some of the alaskite was considered by him to be of metasomatic origin.

Carbonatization.

In the vicinity of the gold deposits carbonatization is a constant feature. Where the country rock is greenstone, microscopic sections show a high degree of carbonatization, and small veins and stringers of calcite are found. At Sekenke mine calcite appears to accompany the second phase of mineralization, and at McCallum's mine ankerite is sometimes abundant.

Phases of Mineralization.

It can be clearly seen in both Sekenke and Kirondatal mines that hypogene mineralization has taken place in at least two phases; and there are indications, which should be verified by ore-microscopic work, that the high gold values were introduced by the second phase. This periodic introduction of mineralizing solutions has been facilitated by the repeated movements of the faults and shears.

DESCRIPTION OF THE MINES

Sekenke Mine. (Map facing p. 44.)

Sekenke mine is the oldest gold mine in Tanganyika Territory, and has been worked since times of German occupation, having produced over £200,000 worth of gold prior to 1914. The gold is carried in a series of parallel quartz veins trending N.W.—S.E. Of these the "Dernburg Reef" is the most important, and the only one to be worked at the present time. It has been opened to a depth of about 700 ft. and is nearly vertical, dipping very steeply to the south-west.

The Sekenke reefs are situated near the border of the granite that lies to the south-west of the Wembere Plains, and the greenstone-volcanic series to the east and north-east; the passage from one to the other is not sharp. The true porphyritic granite is bordered by a band a mile or so wide of fine-grained microcline-aplogranite, which commonly exhibits pegmatitic texture. Between the aplogranite and the volcanics is a band of quartz-diorite 1,000 to 2,000 ft. wide and enlarging to the north-west. The limit between diorite and volcanics is one of passage, large felspar porphyroblasts having developed in the greenstone-schists near the contact. It is therefore concluded that the diorite is a contaminated phase of the granite and probably consolidated before the main batholithic intrusion. This interpretation agrees with that proposed by Eades and Reeve.

The important Dernburg Reef is almost exclusively in the diorite near its contact with the volcanics; it follows a well-marked zone of sheared rock usually 6 ft. wide and visible on the surface for a mile or more, although its actual extent is certainly much greater. There are altogether seven reefs: counting from the north-east they are the "Augusta," the "Sultan," the "Parallel," the "Dernburg," the "Pyritic," the "Porcelain" and a further unnamed reef which is in line with the reef of Papas' mine (see below). The first five reefs occur in the volcanics or the diorite, the last two in the aplogranite.

The band of diorite described, as well as the quartz veins and shears, trend in a N.W.—S.E. direction, and all are crossed by a parallel series of acid dykes trending N.N.E.—S.S.W. Some of the dykes are of pegmatite or microcline-granite, but the majority are quartz-albitophyre of varying texture. The base of the last-mentioned rock is usually formed of fine-grained felspar (albite) laths and granular quartz. The phenocrysts are albite (Ab$_{95}$An$_5$), quartz and hornblende; no potassic felspar is present. The albitophyre may be granular or porphyritic; it often resembles a quartz-porphyry, but albite phenocrysts are usually numerous. The hornblende shows alteration first to biotite, then to a pale pleochroic mica (?hydrobiotite), and finally to chlorite. In the neighbourhood of the shears, the rock may pass to a carbonatized epidote-granulite or an epidosite.

The albitophyres have a considerable importance in the development of the mine and must be briefly considered. When the dykes were intruded they found the shears already present and were diverted along them, penetrating them in the form of tongues. At

a later stage the N.W.—S.E. shears moved again and crushed the dykes. Still later, the quartz reefs were formed in the shear, and their development was interfered with by the dykes, for where the shear crosses albitophyre the quartz reef is either pinched out or carries low values.

It is important to realize that the reef is not dislocated by the dykes ; it continues on its course except for a slight roll or deviation, but the albitophyre constitutes a medium that is unreceptive towards the formation of reef-material or the deposition of gold. The valuable portions of the mine are thus limited to the vertical segments contained between bars of dyke. The reefs are also crossed to the south-east of the present workings by two large dykes of olivine-dolerite. To judge from similar occurrences in other parts of the area, it can be expected that these dykes will cut the reef but will not displace it. They will probably have no influence on the mineralization of the adjacent reef.

A feature of the mine is the albitization and silicification of the dioritic wall-rock. In the neighbourhood of the reefs, the diorite is seen under the microscope to be saturated with quartz, which even penetrates fractures in the hornblende crystals. At a further stage albite appears and a quartz-albite metasome is formed ; this is a characteristic greenish-white rock composed exclusively of albite ($Ab_{95}An_5$) and quartz. The albite is micro-faulted and crushed, and the quartz shows undulose extinction and crushing. Finally this rock becomes quartz reef by a process of silicification. The type of quartz thus produced is a shiny, opaque, white variety of a somewhat greasy appearance ; microscopically it appears to be formed of large grains much crushed and shattered, and it often carries high values. Another type of quartz generally associated with high values is very fine-grained and saccharoidal ; it often fills cracks and shears in the older reef. This quartz appears under the microscope to be uncrushed and thus represents a late phase of mineralization. Calcite and fine-grained tourmaline are often associated with this late phase. In the Sekenke quartz there is a very small proportion of sulphides, principally finely disseminated pyrite. Specks of galena are of rare occurrence.

Exploitation has been largely confined to the section of the mine that lies to the south-east of a bar of dyke crossing the Dernburg Reef in the neighbourhood of the Main Shaft and continues for some 1,000 ft. in this direction. The Dernburg Reef is here divided for part of its course into East and West Reefs, which unite in depth before reaching the fifth level. The average width is from 6 ft. to 7 ft., and the values are patchy. Remarkably high values were recovered in the first level owing to surface enrichment, but in depth a 7 dwt. milling grade can be maintained. The best values are found in an ore-shoot pitching about 45° to the south-east at the sixth level, and about 1,000 ft. south-east of the main shaft ; this shoot encounters tongues of dyke that interfere with the free development of the reef. Below the sixth level the shoot plunges vertically, and high values have been exploited in a winze sunk to open the seventh level; this concentration of gold is probably due to the blanketing action of the adjacent albitophyre dyke.

In the Dernburg Reef the high values are often limited to a narrow zone that usually lies near the foot-wall. It is believed that this feature is due to the late phase of shearing already mentioned having caused fractures in the reef that permitted the introduction of gold-bearing solutions of the second phase of mineralization.

Sekenke mine is difficult to exploit, as the values are patchy, and barren portions of the reef are frequently encountered. The mapping and investigations carried out by the writer, however, lead to the conclusion that the Dernburg Shear is a tectonic feature of importance, and that it is likely to extend to a considerable depth. Study of the mineralization and wall-rock alteration shows that both proceed from some deep-seated source, and values can therefore be expected to continue in depth. Furthermore, the second phase of mineralization mentioned above is more widely found in the lower levels than near the surface, and there is thus the probability that good values will be found as development proceeds.

Union Gold Mines. (Map facing p. 44.)

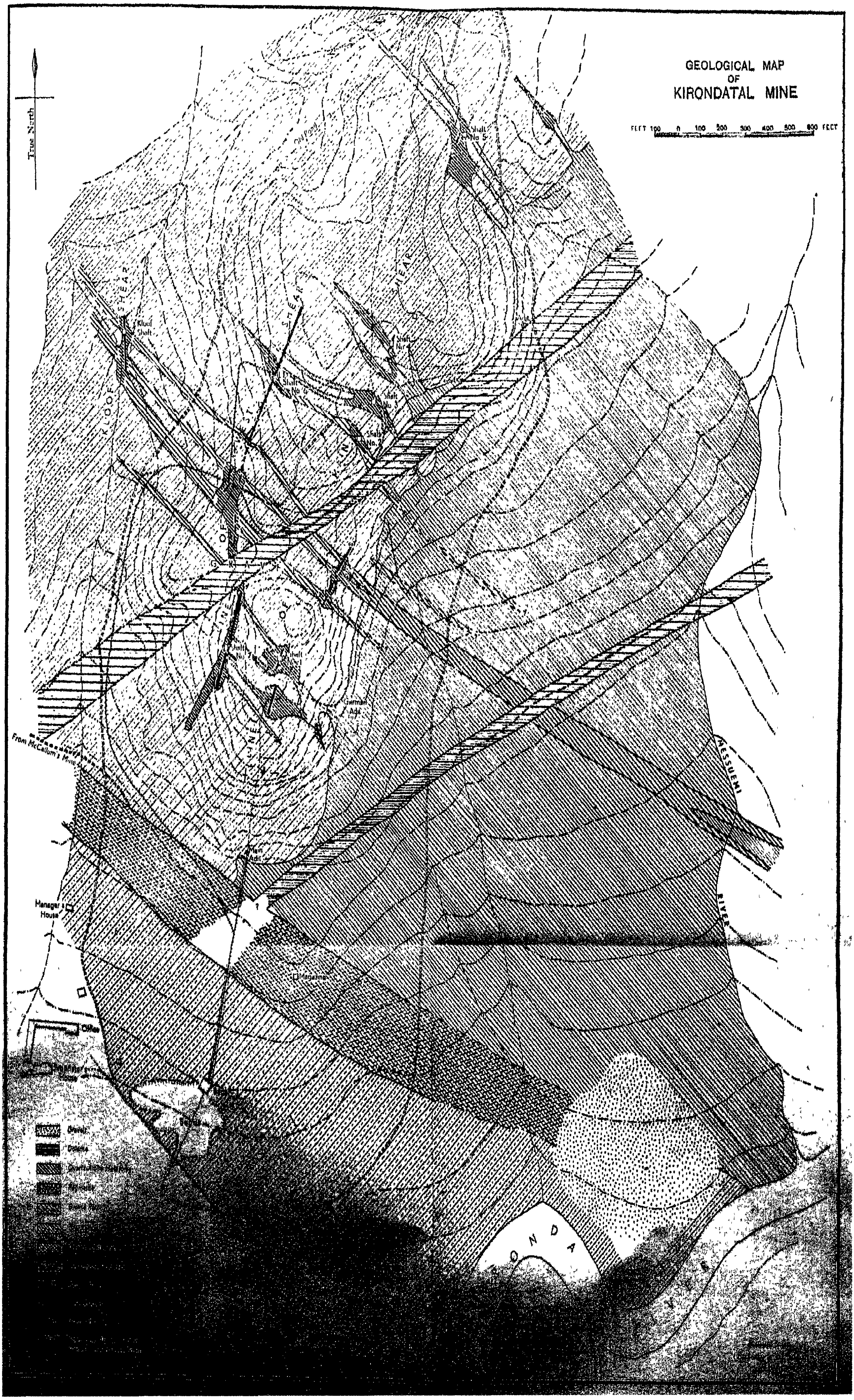
To the south of Sekenke and belonging to the same N.W.—S.E. vein system are two mines known as Papas' mine and Kikkides' mine. They are at present united under one management with the name Union Gold Mines.

Papas' mine is a quartz reef in a well-marked vertical shear, 3 to 4 ft. wide, and in the continuation of the Sekenke diorite band. The vein is interrupted by an albitophyre dyke, to the south-east of which high values were exploited near the surface. The reef has been worked to a depth of some 70 to 90 ft. by a number of shafts, but little is known of the values in depth. It is possible that this reef continues to the north-west for a considerable distance: if this is so, it would enter the aplogranite mentioned on page 44. Good values in consolidated superficial gravels are in fact found in this direction.

Kikkides' mine lies 1 mile to the west and possibly consists of more than one reef; that open to examination, however, was found to average 2 to 3 ft. in width, and, while maintaining the usual N.W.-S.E. direction, to dip 45° towards the south-west. The reef has been opened to about 80 ft. and the values found to be patchy; it is formed in a well-marked shear in fine-grained aplogranite that sometimes carries large flakes of white mica. In the neighbourhood are extensive deposits of gravels carrying sufficient gold values to warrant their exploitation.

Kirondatal Gold Mine. (Map facing p. 46.)

This mine is near the Kironda River and some six miles to the


GEOLOGICAL MAP
OF
KIRONDATAL MINE
True North
FEET 100 0 100 200 300 400 500 600 FEET
Shaft No 5
Kloof Shaft
KLOOF SHEAR
SHEAR
Shaft No 4
Shaft No 3
Shaft No 2
Shaft No 1
German Adit
Main Adit
From McCallum's Mine
Manager's House
Magazine
Office
KESSUEMI
RIVER
ONDA
Gravel
Dolerite
Rhyolite

east of the western scarp of the Iramba Plateau. It was known and exploited in the days of German occupation, but has only recently attained any importance. The deposit consists of quartz veins in a number of parallel shears, trending N.—S. varying to N.N.E.—S.S.W., and developed in a greenstone-volcanic series dipping nearly vertically and directed parallel to the shears. Close to the east is a cupola of porphyritic granite, which meets the greenstone along a sharp but somewhat meandering contact.

The so-called " Main Shear " trends N. 20° E., more or less parallel to the granite contact and on an average about 100 yds. from it. Further west is the " West Shear," followed by the " Kloof Shear " and two " Boundary Shears."

The geology of the mine is peculiar and recalls in some degree the gold mines of Berezovsk in the Urals.[1] A number of dykes, of two types, pegmatite and diorite-porphyry (carrying phenocrysts of andesine and hornblende) issue from the granite and cut through the greenstone series in a N.W.—S.E. direction, thus crossing the shear system at an angle. That the shears were present before the intrusion of these dykes is shown by the fact that the dykes are diverted and enlarged where they cross the shears, and often a large mass of intrusive rock is formed at these crossings. The intrusive rock, whether normal pegmatite or diorite-porphyry, has been altered in the neighbourhood of the shears to a fine-grained white rock composed of albite ($Ab_{95}An_5$) and quartz identical with the altered wall-rock noted at Sekenke. It is exclusively in this quartz-albite metasome that ore-shoots are developed. The shears themselves, though persistent, do not always carry much quartz. Occasionally, narrow veins of quartz in the shears where they cut greenstone-schists are payable, but it is not likely that much gold will be found away from the cross dykes.

Prior to the erection of the mill in 1934, there was an irregular production from the dollying of enriched surface outcrops. In 1934 and 1935, returns show that production was respectively 1,521 and 1,255 fine oz. Thereafter production dwindled almost to vanishing point until 1939, when a rich ore shoot was discovered in shaft No. 3, where a large mass of quartz-albite metasome was found at the junction of the Main Shear and a pegmatite dyke. This ore shoot was in the form of a lens 100 ft. long and 15 ft. across at its greatest width. The lens did not quite reach the surface, and it has been worked to about 100 ft. without showing signs of diminishing. The average value is said to be high, and for the year 1940, 1,505·6 fine oz. of gold were produced. The gold is carried in quartz with a fairly high proportion of sulphides, and visible gold is common. In the oxide zone a seam of hematite 6 in. or more wide was often found in the reef; when the sulphide zone was reached this seam was found to consist of pyrite, arsenopyrite and pyrrhotite with some subordinate chalcopyrite and zinc blende. Crystals and vugs of all these sulphides are found throughout the lens. This band of sulphides suggests a second phase of gold-bearing mineralization comparable to that noted at Sekenke.

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[1] *Mineral Deposits*, by W. Lindgren (McGraw-Hill, New York); Fourth Edition, 1933, pp. 146, 683.

A number of other similar ore-shoots of minor importance are known in connection with the Main Shear and the West Shear, but exploitation has not proceeded far enough to permit of an estimate of their value. A characteristic of these bodies is the presence of small veinlets of fine-grained tourmaline.

The Kloof shaft is sunk upon a body of quartz-albite metasome that has formed where a dyke of diorite-porphyry crosses the Kloof Shear. High surface values have given place at 60 ft. to quartz with a sulphide content of 2·5 per cent. The sulphide is exclusively arsenopyrite and carries all the gold. Some high assays obtained from this body should encourage further investigation.

Ore-bodies are also found further west in the Boundary Shears, but values are low. Since, however, the high values found on the Main Shear are near the granite, it is possible that valuable ore-shoots may be found in depth in the Boundary Shears.

It is interesting to note that all the shears are cut off to the south by a wide dyke of quartz-albitophyre similar to the acid dykes at Sekenke. This rock appears whiter and more granular than the Sekenke type, but it has undoubtedly suffered severe crushing and faulting, since the schists to the south of it are directed N.W.—S.E. and not N.N.E.—S.S.W. as in the mine to the north.

A dolerite dyke some 50 ft. wide crosses the mine from S.W.—N.E. and cuts the reefs; the evidence shows that it post-dates both the shearing and mineralization.

Kirondatal mine is still at an early stage of development, but the results already obtained are sufficient to warrant a thorough diamond drilling campaign. Such a campaign could be based on the geological map attached to this paper and guided by the above remarks.

Escarpment Mine. (Fig. 1.)

The Escarpment mine is situated in a shear at the top of the western escarpment of the Iramba Plateau. The shear is well-marked and strikes N. 20° E., dipping 45° to the east; it can be followed for several thousand feet on the surface and sometimes contains quartz. The gold is carried in an ore-shoot consisting of a quartz vein averaging 18 in. in width and showing a strike of about 100 ft. The vein has been opened to a depth of 90 ft., where it continues to carry good values. The ore-shoot is probably at the junction between the shear and a series of lenticular quartz veins striking E.—W.; there is thus a good chance that it will continue in depth. The mine is 7 miles north-west of Kirondatal mine, with which it is connected by a motor track.

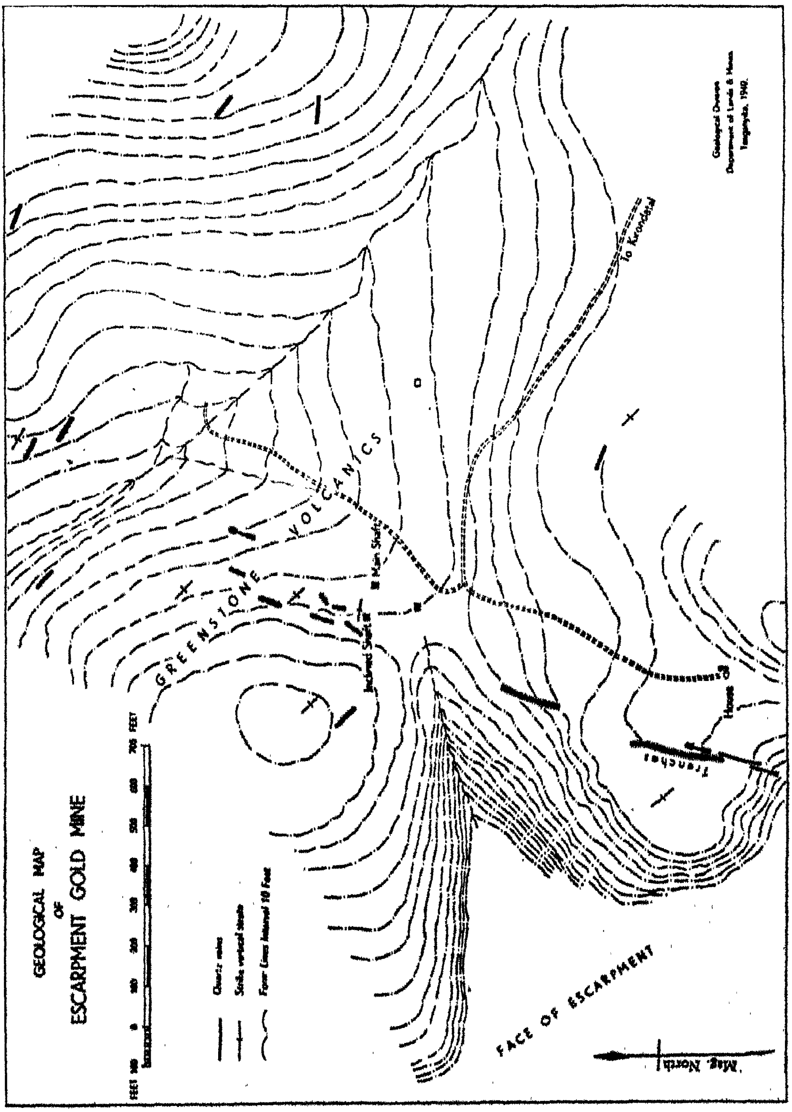
GEOLOGICAL MAP
OF
ESCARPMENT GOLD MINE
FEET 100 0 100 200 300 400 500 600 700 FEET
Quartz veins
Strike vertical strata
Form Lines Interval 10 Feet
GREENSTONE VOLCANICS
Main Shaft
Inclined Shaft
House
Trenches
FACE OF ESCARPMENT
Mag. North
Geological Division
Department of Lands & Mines
Tanganyika. 1940.

FIG. 1.

McCallum's Mine. (Fig. 2.)

This mine is situated 1½ miles north of the Escarpment mine. The geology of both mines is similar, but at McCallum's there are at least three parallel shears carrying ore-shoots. Since these shears are all well marked and persistent, it is unlikely that the reefs will pinch out in depth. The mine has been quite extensively worked at various times, but the frequent faults render mining difficult. The quartz contains sulphides, principally pyrite and chalcopyrite, as well as a good deal of ankerite, and high values were recovered near the surface.

The ore-bodies have formed, in a similar manner to those of the Escarpment mine, at the junction of E.—W. and N.W.—S.E. lenticular veins with the N.—S. shears.

Mkingi River Reefs.

A number of quartz veins in the neighbourhood of the Mkingi River show good values on surface. These veins, in spite of showing remarkable continuity in a N.W.—S.E. direction (parallel to the greenstone-volcanic series), are not in definite shears, and values in depth are disappointing.

The quartz veins are sometimes paralleled by narrow dykes of albitophyre. It is possible that an ore-shoot may be found at the junction of these reefs with other cross reefs.

Kinyalele Mine. (Fig. 3.)

This mine is situated near the eastern scarp of the Iramba Plateau and is 19 miles by road from Kinyangiri railway station. It presents very peculiar features, and the result of the present study is that the mine warrants thorough investigation by diamond drilling, as a large low-grade ore-body may possibly exist in depth. The mine is situated in a meta-sedimentary series of quartzites and semi-pelitic mica-schists directed N.35° E. and dipping 45° to the south-east. In this series is a succession of banded quartzite beds 10 to 30 ft. wide, the most easterly of which constitute the lodes of Kinyalele mine.

Detailed geological mapping of the property showed that the three lodes recognised were all part of the same quartzite band isoclinally folded as shown in the accompanying figure. No. 3 lode is the most easterly of the quartzite bands, and this fact, in addition to its lenticular nature, leads to the belief that it marks the plane of a thrust-fault. To the west of the mine the often recurring quartzite bands are barren. The isoclinally folded lode is a complex syncline and has the form of a deep, narrow trough. The whole trough pitches to the north-east at an angle of 35 to 37°, and this attitude renders the axis of the folds visible on the surface. The lodes themselves are contorted in a series of small isoclinal folds, the axes of which are more or less parallel to the axis of the main trough-fold. (Fig. 4.)

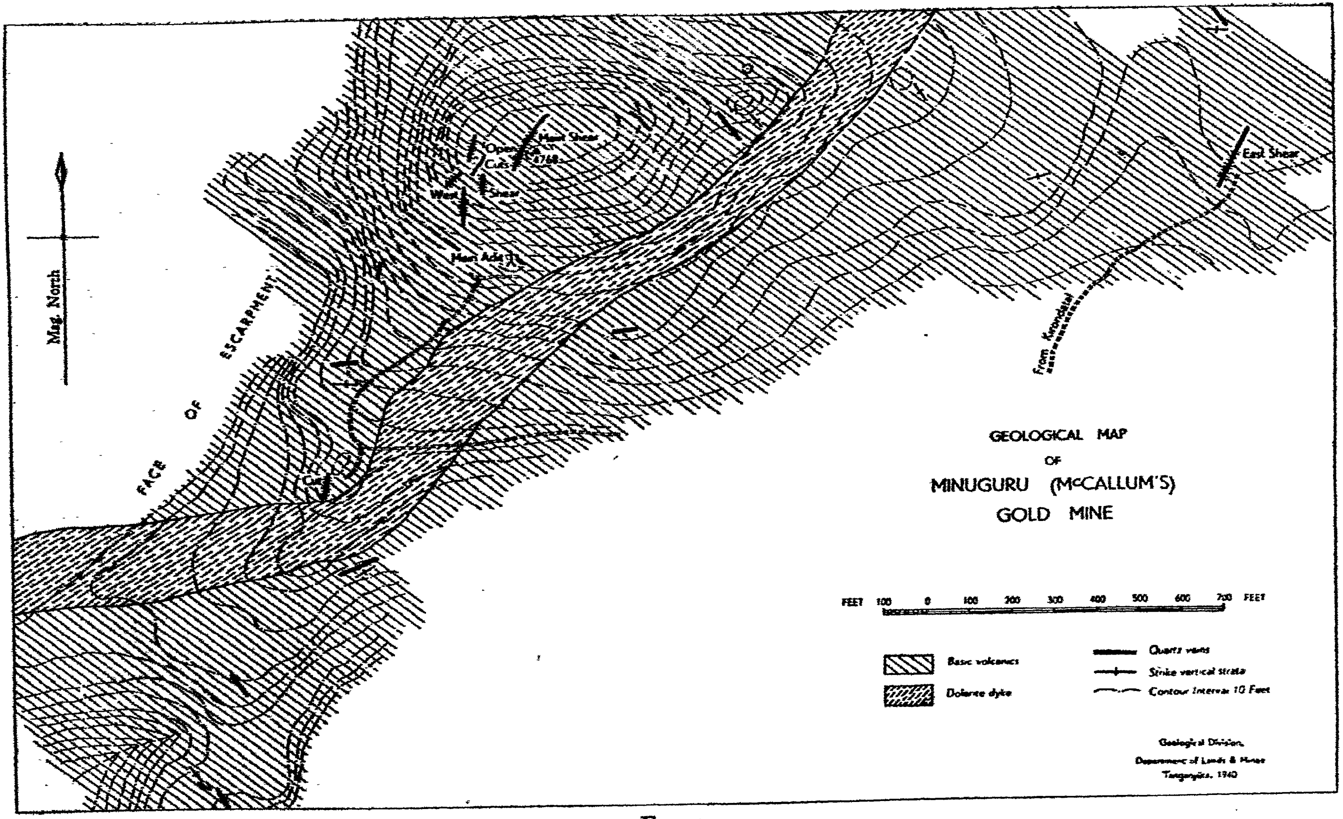
Mag. North
FACE OF ESCARPMENT
Main Shear
Open Cuts
4768
West Shear
Main Adit
East Shear
From Krondal
GEOLOGICAL MAP OF MINUGURU (McCALLUM'S) GOLD MINE
FEET 100 0 100 200 300 400 500 600 700 FEET
Basic volcanics
Dolerite dyke
Quartz veins
Strike vertical strata
Contour Interval 10 Feet
Geological Division,
Department of Lands & Mines
Tanganyika, 1940

FIG. 2.

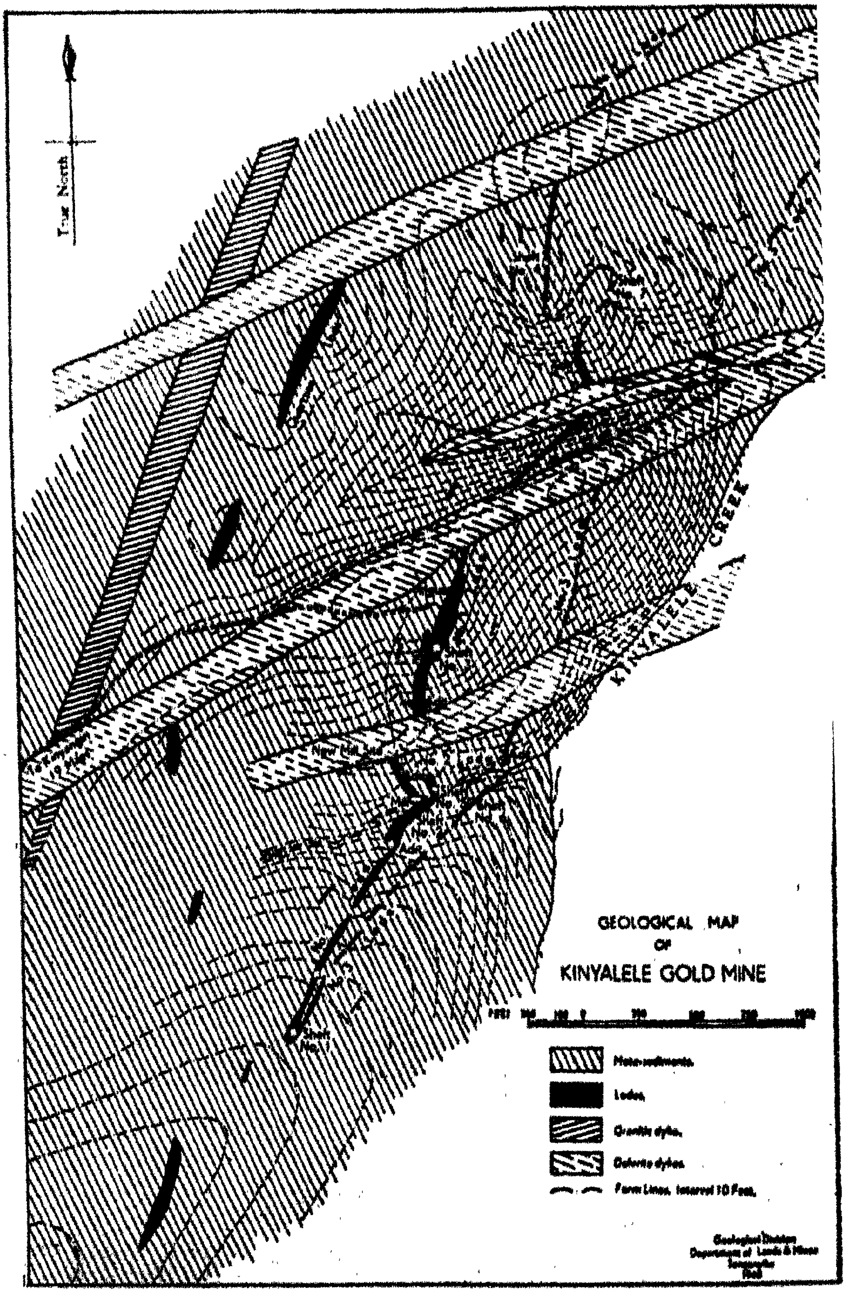True North
KINYALELE CREEK
Shaft No. 1
GEOLOGICAL MAP
OF
KINYALELE GOLD MINE
Feet 100 50 0 250 500 750 1000
Meta-sediments.
Lodes.
Granite dykes.
Dolerite dykes.
Form Lines. Interval 10 Feet.
Geological Division
Department of Lands & Mines
Tanganyika

FIG. 3.

Lode No. 3 may be followed some two miles to the north-east where it approaches a granite cupola; neither the contact nor the extent of the granite is visible owing to the superficial cover.

The lodes themselves are of a very unusual composition; they are from 10 to 30 ft. wide and consist of repeated narrow bands of (1) garnet crystals, (2) balls and aggregates of fibrous amphibole, and (3) quartzite containing small garnets and fibrous amphibole. The mineralogical and mineragraphical study of these lodes has not yet been completed, but it is concluded that the peculiar composition has resulted from metasomatism due to the proximity of the granite.

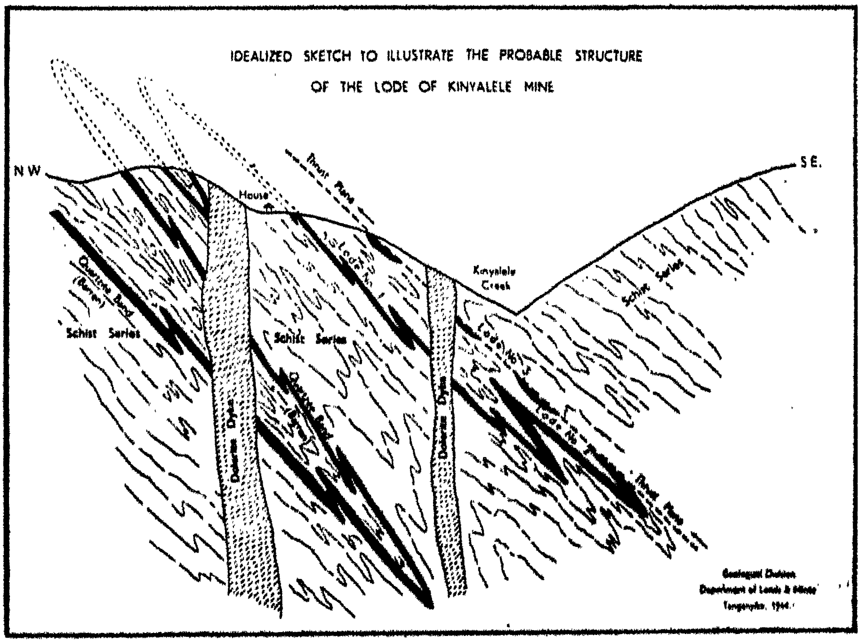

FIG. 4.

Since the barren quartzite bands to the west have been metamorphosed only to a very slight extent, it is likely that the phenomenon was facilitated by the passage afforded to ascending vapours by the thrust plane at No. 3 Lode and by the deep trough pitching towards the granite. As was pointed out by Teale and Oates (*Tanganyika Terr. Geol. Surv., Ann. Rep.* 1934, p. 52), gold is found in similar lodes in the Dahlonega District of Georgia, U.S.A.

The lodes are mineralised by pyrite and pyrrhotite, but the condition of the gold is not yet known, though it is supposed to be free milling. Polished sections show sulphides replacing fibres of the amphibole and filling cracks in the garnets, but the little gold that has been seen microscopically is not enclosed by sulphide. Fibres of gold have, however, been found when panning ore from the oxide zone, and the replacement of amphibole by gold is thus suggested. A succession of olivine-dolerite dykes cross the lodes; they are later than the mineralisation.

The mine has been worked on a small scale for some years and 472 oz. of gold bullion produced. The average value on the surface appears to be 3 dwt., but samples from the bottom of the Kinyalele stream give values up to 6 dwt. over several feet. The possibility that a large body of ore lies in the trough pitching towards the granite should be thoroughly investigated.

ABSTRACTS AND NOTES

Obituary.—Miss R. C. Groves.—We deeply regret to record the death, on December 15, 1944, of Miss R. C. Groves, M.Sc., F.R.I.C., senior assistant in the laboratories of the Mineral Resources Department.

Miss Groves, who was born in 1892, received her scientific training at Birmingham University, where she took her B.Sc degree in Chemistry and Botany, and M.Sc. in Botany. Prior to her appointment at the Imperial Institute in 1918, she was engaged for some time in the Metallurgical Branch of the Royal Arsenal at Woolwich. Although her early scientific bent was mainly botanical, she became an expert mineral chemist, but maintained an indirect association with her early studies by her interest in agricultural subjects, particularly in connection with the influence of soil composition on crop production. She was a recognised authority on soil analysis, her published work on this subject including contributions in 1928 and 1933 to the *Journal of Agricultural Science* on "The Mechanical Analysis of Heavy Ferruginous Soils" and "The Chemical Analysis of Clays, with special reference to Clay Fractions of Soils." She also made many contributions to this BULLETIN, one of the principal being an article in 1932, dealing with "Producer Gas as Fuel for Motor Vehicles."

On her promotion to Senior Assistant in 1929 she had the task—one which might conceivably be difficult for a woman—of leading a team consisting, with one exception, of men assistants. Her tact and temperament were such, however, that the duties were admirably performed. In fact, in the whole of the 25 years during which the writer was associated with her, he does not recollect a single instance of friction or disharmony. She took a great pleasure in her work, and though it was inevitable that she should share the uncongenial tasks which are of necessity occasionally encountered in the routine of a chemical laboratory, she never, even in jest, made any complaint, and in spite of the ill-health from which she suffered latterly, performed every duty with unfailing cheerfulness and interest. She was a loyal colleague, who had earned the respect and affection of her associates, and her untimely death, at a comparatively early age, leaves them with a real sense of personal loss.

W. O. R. W.

Sierra Leone Produces World's Largest Alluvial Diamond.—Through the courtesy of Sierra Leone Selection Trust, Limited, we are permitted to announce the discovery on January 6, 1945, of what is probably the largest diamond of gem quality yet found in an alluvial deposit. This remarkable stone weighs 770 carats and came from the same workings in Sierra Leone as did the two other large diamonds (250 and 530 carats), the discovery of which was first announced in this BULLETIN, 1943, **41**, 206.

The stone was recently brought to England and is stated to be an irregular cleavage block of exceptionally fine colour and quality. It is the third largest gem diamond so far found in Africa, having been surpassed in size only by the Cullinan (3,106 carats), which came from the Premier mine in 1905, and the Excelsior (995.2 carats) found in the Jagersfontein mine in 1893; but both these came from kimberlite pipes. The new Sierra Leone stone weighs 44 carats more than the Jonker, found in 1934 in alluvial deposits near the Premier mine and subsequently sold to the Diamond Corporation for £75,000. It is the largest gem diamond ever found in an alluvial deposit in Africa, and perhaps in the world, for it exceeds by 43·4 carats the President Vargas found in 1938 in Brazil, and there is no reliable evidence as to the original weights of two legendary Indian stones reputed by some authorities to have been slightly larger.

The Sierra Leone diamond field developed with great rapidity after working commenced in 1932, and according to Sydney H. Ball's estimate, the annual output in recent years has been of the order of 850,000 carats, valued at about £1,000,000.

It provides one of the most striking examples of the practical value of geological work in the Colonies, for the original discovery of diamond in Sierra Leone was made by Geological Survey officers in 1930.

G. E. H.

Recent Analyses and Tests of a Kenya Diatomite.—The following note has been kindly forwarded by the Commissioner of Mines, Nairobi, Kenya.

The occurrence of extensive deposits of diatomite in the Rift Valley areas of Kenya has been known for many years. Analyses of some were made by the Imperial Institute as long ago as 1910, and analyses in connection with manufacture of tiles were published in this BULLETIN, 1921, **19**, 306, followed by further analyses in the Imperial Institute monograph, "Diatomaceous Earth," published in 1928.

Recently one of the deposits, situated in the valley of the River Kariandus on the Cole Estate near Gilgil, has been exploited, largely for use in the manufacture of cheap grades of local soap. In an endeavour to determine the value of the rock for other purposes, the Mining and Geological Department of Kenya have examined the deposit and carried out various tests.

The quarry being worked shows a succession of tuffs and diatomite of Pleistocene age and 51 ft. 9 in. in thickness. There are six bands of diatomite with thicknesses (upper band downwards) of (1) 2 ft. 3 in., (2) 4 in., (3) 6 in., (4) 1 ft. 5 in., (5) 6 in., and (6) the main band, 34 ft. 6 in. exposed. Each of these bands, except No. 5, has been sampled, four samples being taken over the main band, with a composite sample derived from those four. The silica and loss on ignition figures for these samples are as follows (per cent.):

Band.	1.	2.	3.	4.	6a.	6b.	6c.	6d.	6a-d.
SiO_2 .	80·33	83·06	71·06	71·68	82·66	81·77	83·55	85·20	84·19
Loss .	6·99	6·55	8·32	7·00	6·19	5·86	5·33	5·35	5·51

Analyst: A. F. R. Hitchens, Government Chemist and Assayer.

Fuller analyses were made of a sample from Band 6d. and of a composite sample of Bands 6a-d. with the following results:

	SiO_2.	Al_2O_3.	Fe_2O_3.	CaO.	MgO.	Alkalis as Na_2O.	Ignition Loss.	TiO_2.	Total.
Band 6d.	85·20	4·63	2·80	0·28	0·13	1·45	5·35	0·30	100·14 per cent.
Band 6a-d.	84·19	4·67	3·04	0·36	0·28	1·74	5·51	0·20	99·99 per cent.

Analyst: A. F. R. Hitchens.

These analyses of the main band are of interest as they show higher silica contents than have been previously recorded for Kenya diatomites. A comparison with other analyses, calculated free of ignition loss, is given in the Table on page 57.

The amount of soluble silica, which may be taken as an indication of the proportion of diatoms present, was determined in several cases by the Imperial Institute; the figures are maxima, as usually some non-diatomaceous opaline silica is also present:

	1.	3.	6.	7.	8.	9.	10.	11.
Soluble Silica (*per cent.*)	71·22	66·29	61·20	61·50	65·04	71·22	33·65	31·50

Determination of soluble silica has not been carried out in the new analyses, but the following approximate modal analysis has been calculated from the chemical analysis of Band 6d.: Diatoms 75·77, volcanic glass, 13·08, kaolin 8·89, ilmenite 0·57, haematite 1·30, calcite 0·36; total 99·97.

This modal analysis is based on the assumption that the volcanic glass present has the composition indicated in an analysis by G. T. Prior of obsidian (glassy soda-rhyolite) from the Lake Naivasha district (*Minerological Mag.*, 1903, 13, 246). The proportion of volcanic glass is based on the total alkalis present; the balance of alumina left after calculation of the glass is allotted to kaolin; the balance of silica remaining after allotment of the requisite quantities to volcanic glass and kaolin is assumed to represent diatoms; and after subtraction of the small amount of lime required for the glass, the remaining lime is calculated to carbonate. The method of

COMPARISON OF KENYA DIATOMITE ANALYSES
(All calculated free of ignition loss.)

	1.	2.	3.	4.	5.	6	7.	8.	9.	10.	11.	12.	13.	14.
SiO_2 . .	87·3	81·4	79·6	59·8	81·5	81·5	81·9	87·2	87·4	67·8	66·1	89·9	89·1	93·1
Al_2O_3 . .	6·3	9·7	7·9	34·9	9·7	7·6	8·4	5·2	6·3	23·3	23·2	4·9	4·9	3·5
Fe_2O_3 .	2·4	5·2	5·8	4·3	5·2	3·4	3·4	2·5	2·3	4·6	4·7	2·9	3·2	1·1
CaO . .	1·5	1·2	2·1	0·5	1·2	0·[illegible]	1·7	1·5	1·4	0·5	1·3	0·3	0·4	0·4
MgO . .	0·5	0·6	1·5	0·3	0·5	1·0	0·9	1·0	0·5	0·4	0·7	0·1	0·3	0·7
K_2O . .	1·3	0·6	1·2	0·1	0·6	1·8	1·3	0·5	1·3	1·7	1·0	1·5	1·8	0·9
Na_2O . .	1·2	1·2	1·7	0·4	1·2	2·5	2·1	1·2	1·2	2·4	2·9			
TiO_2 . .	—	—	—	—	0·2	Trace	Trace	—	Trace	Trace	—	0·3	0·2	0·1
	100·5	99·9	99·8	100·3	100·2	99·9	99·7	99·4	100·4	100·7	99·9	99·9	99·9	100·1

1. " Diatomaceous Earth," Imperial Institute, 1928, p. 16 Enderit
2. *Ibid.* Naivasha.
3. *Ibid.* Magadi Branch Line
4. BULL. IMP. INST., 1921, **19**, 305. Elmenteita. (This is clearly an analysis of a kaolinitic deposit, not of a diatomite.)
5. *Ibid.* Naivasha.

6 & 7. Report by the Imperial Institute to the Government of Kenya, dated January 5, 1911. Kariandus River, Gilgil.
8 & 9. *Ibid.* Enderrit River, about 4 miles S.W. of Elmenteita station.
10 & 11. *Ibid.* Mbugonoto, N.E. of Nakuru.
12 & 13. Recalculated from analyses (given in text) of 5d and 5a-d respectively. Kariandus River, Gilgil.
14. " Industrial Minerals and Rocks." Seeley W. Mudd series, *Amer. Inst. Min. Metall. Eng.*, 1937, p. 244 Lompoc, California. (May perhaps be considered the world's best diatomite.

calculation was judged to be reasonable—though naturally yielding an approximation only—from microscope examination of the diatomites.

This computation of diatom content, though not strictly comparable with the Imperial Institute soluble silica determinations, gives a good idea of the proportions of diatoms and impurities in the newly analysed samples. It seems clear that the Kariandus deposit at present being worked is superior to other Kenya diatomites.

The diatomite of the main band in the Kariandus quarry is as a whole a dazzling white rock. In its upper portions it contains occasional lenses of volcanic ashes, and in other parts occasional knots of iron-staining. These are, however, readily rejected during quarrying operations. The apparent block density is approximately 28 lb. per cu. ft., and the apparent powder density of the rock, gently crushed and passed through a 120-mesh sieve, is 7½ to 9 lb. per cu. ft. Wet screening shows that from about ½ to 9 per cent. is retained on a 200-mesh sieve according to the derivation of the sample, and it is apparent that much of the non-diatomaceous impurity is in a fine state of division. The residues recovered include calcareous tubules and plates, occasional felspars and sometimes quartz grains, and predominantly grains of pumice and volcanic glass.

Microscope examination indicates that the predominant diatom in the main band is a species of *Melosira*. It is accompanied by a few large *Pinnularia*, and two species of *Eunotia*. Circular forms of varying diameters are variably present. There is also a fair proportion of diatomaceous detritus.

A few tests have been carried out to determine the absorptive capacity of the diatomite, and these indicate that samples, after ignition, will absorb from about 3 to 3½ times their weight of water. Such ignited samples appear to absorb little moisture from the atmosphere under East African conditions.

Geological Work in Nigeria, 1943.—The Annual Report of the Geological Survey of Nigeria for 1943 is of special interest, for although field activities during the year were hampered by lack of staff, it contains valuable reports on the wolfram and tantalite deposits, a review of Nigerian stratigraphy, notes on the distribution of minerals and groundwater, and a new edition of the 1 2,000,000 coloured geological map of Nigeria.

The investigation of wolfram deposits, begun in 1942, was continued during the year, but owing to decreased demand for the mineral, was brought to a close at the end of the field season. Eight areas were examined in 1943 and these are described and illustrated by geological maps on the scale of 1 : 125,000. The Gabbas deposits in the Afu Hills area (Benue Province) include two ore bodies which are the largest individual wolfram deposits yet found in Nigeria. They form irregular pipes in metasomatised granite, apparently converging at depth, one from 5 to 13 ft. wide and the other attaining a maximum width of 25 ft. The ore consists of sphalerite, chalcopyrite and pyrites with cassiterite and wolfram set in a mass of siderite, fluorite, quartz and green biotite. From an adjacent orebody a 9 ton block of cassiterite was won. It is unfortunate that the by-product zinc and copper sulphides cannot be sold owing to transport costs, but given high prices and demand for wolfram the Gabbas deposits may continue to be workable. Attention is also directed to the presence of columbite in the Afu Hills, where it was discovered as recently as 1942.

In the Mada Hills the wolfram veins are of the type which provide quickly worked out detrital deposits, but are too small and scattered to be mined economically, and in the Shona Hills mining will become uneconomic as soon as the limit of opencast working is reached. In the other five areas investigated the prospects for wolfram were even more unpromising. As wolfram investigations are now at an end, for the time being at least, a general review is made of the Younger Granite mineralisation in relation to the occurrence and genesis of the wolfram deposits. This touches upon many interesting topics, such as the association of strongly magnetic cassiterite with columbite, and the presence of columbium in clean homogeneous wolfram to the extent of probably a few per cent.

A preliminary report is made on the pegmatites of central Nigeria which are worked on a small scale for cassiterite and have recently become of some importance as sources of tantalite. These pegmatites are older than, and have no apparent connection with, the Younger Granites with which most of the cassiterite and columbite of Nigeria is associated. The most promising areas for tantalite appear to be in Kabba Province, e.g. near Egbe, but in general the search for tantalite is like looking for a needle in a haystack.

In the ten years which have passed since the previous issue of the 1 : 2,000,000 provisional geological map of Nigeria was published, new evidence has accumulated which has necessitated a major revision of Nigerian stratigraphy and the new map is therefore very different from its predecessor. The principal changes relate to the classification of the Cretaceous and Tertiary sedimentary rocks ; the Cretaceous system is now sub-divided into an Upper and Lower division, divided by an inferred major unconformity between Turonian and Albian ; wide areas of unfossiliferous sands and clays in north-western and central Nigeria previously classed as Tertiary are now referred to the Turonian and Post-Turonian Cretaceous ; and finally, the old Benin Sands group is no longer recognised as a stratigraphical unit, as some of the sands are now known to be Cretaceous while others are Eocene. Furthermore, in many parts of the map the geological boundaries have been revised, and in the Bamenda area of the Cameroons a large area of volcanic rocks (Tertiary-Recent) is shown for the first time. All the important mineral deposits are shown on the map by symbols.

From the notes on the distribution of minerals in Nigeria the following tabular summary has been drawn up to show the age relations of the economic minerals; those shown in italics occur in deposits not yet worked or of uncertain economic value.

Formation	*Economic Minerals*
Chad Group . . .	*Diatomaceous Earth.*
Post Middle-Eocene .	*Lignite.*
Eocene . . .	Limestone, *Phosphate, Bitumen.*
Upper Cretaceous . .	Coal, Limestone, *Petroleum see pages, Iron Ore.*
Older Cretaceous . .	Lead-Zinc, Brine, *Fluorite.*
Younger Granites . .	Tin, Columbite, Wolfram.
Pre-Cambrian Pegmatites	Tin, Tantalite, *Rutile, Beryl.*
Pre-Cambrian Schists .	Gold, *Talc.*

T. D.

Mineral Discoveries in Uganda.—Exports of valuable minerals from Uganda began in 1927 with the production of 114 tons of tin ore, and this was followed by the working of gold in 1931. The output of tin steadily rose until 1936 and that of gold until 1938, since when there has been a steady decline in the production of both minerals. Exports of bismutotantalite, columbite-tantalite, wolfram, bismuth and asbestos followed, and a valuable record of these and of all other discoveries of minerals of economic or of potential economic importance was published in the Geological Survey Department's "Mineral Resources of Uganda" in 1942.

Supplement No. 1 to this publication appeared in August 1943. Supplement No. 2, dated August 1944, recently received in this country, announces a number of additional mineral discoveries and developments of interest, and from it most of the following notes have been taken.

Amblygonite, the leading ore of lithium, was first identified in Uganda in 1930 at Nampeyo Hill, in the then recently abandoned bismutotantalite workings, by the compiler of this note (*Ann. Rep. Uganda Geol. Surv. Dept.* for 1930, pp. 16-17). This amblygonite occurred in large lumps in a pegmatite together with lepidolite and bismutotantalite.

Amblygonite has been found in quantity in three localities within the past year. By far the largest of these occurrences is at Mbale, 81 miles from Kampala on the Mubende road, where it occurs in a pegmatite which outcrops over an area measuring about 50 yds. by 100 yds., and probably extends much farther up the slope. The amblygonite in the vein bulks to a greater extent than any other mineral, even quartz, and is represented at the surface by large boulders usually several feet across. Seven tons of beryl and half a ton of columbite have also been taken from between the amblygonite boulders. It is estimated that up to a hundred tons of amblygonite could easily be won from the superficial part of this deposit. Transport charges to Mombasa would be between Shs. 135 and Shs. 155 a ton, and a market in the United Kingdom is now being sought.

Apatite.—A band of country about 1 mile wide and 11 miles in circumference surrounding a central limestone mass in the Butiru (Bugishu, Eastern Province) region has been found to be underlain by mixed magnetite-apatite-phlogopite rocks. Magnetite is the dominant constituent in this band and phlogopite the smallest. Close prospecting has been carried out by means of pitting, and some core drilling is now being done. Average samples on one hill show a content of 12 to 13 per cent. P_2O_5 over a wide area, and on another ridge 5 million tons of rock with between 8 and 35 per cent. P_2O_5 are estimated to occur. Beneficiation is comparatively simple and is being carried out by magnetic methods.

The apatite has been altered in the zone of weathering to a type of phosphate known broadly as phosphorite. These secondary minerals are concretionary, and when examined under the microscope can be seen to consist of radiating, fibrous, nodular bodies, usualy $\frac{1}{16}$ in. or less across, which often have a core of rounded apatite; it is considered probable, therefore, that the mineral is dahllite or staffelite. Analyses show that the rock has a lower fluorine content than apatite proper and, when finely ground, is citric-soluble and of considerable value as a fertiliser. The depth to which these secondary deposits are present is being tested by drilling and will probably be found to be generally from 60 to 130 ft.

Some 11,000 tons have been ordered by Kenya authorities, and mining has already begun. It is the intention later to manufacture a phosphatic fertiliser of the Rhenania type to supplement the crushed material. A new road which has just been completed brings the workings within 9 miles of a railway station.

Beryl.—A quotation of $90 a ton for beryl with 10 per cent. BeO, f.o.b. Mombasa, having been made by the United States authorities, production of beryl has been undertaken at Mbale in addition to working the amblygonite at that occurrence. Production of beryl has also commenced at Lunya, 5 miles from Lugazi and 37 from Kampala. In both places it occurs in masses several feet across, and at Lunya it is also often crystalline in form.

The beryl at Lunya is associated with felspar, mica and columbite; it is colourless, blue-green or pink, while that from Mbale is cream or colourless and is marked by columnar structure. Seven tons were shipped during the first six months of 1944, but further output depends on the ability to make the working of the associated minerals a paying proposition.

Bismutotantalite.—This mineral has been accepted by the American authorities as an ore of tantalum, and production has commenced at the locality where it was originally found, namely Nampeyo Hill, 25 miles W.N.W. of Kampala. It occurs with columbite of about 50 per cent. Cb_2O_5, and it is estimated that at least 15 tons of concentrates are available; owing to the unique character of the mineral, well-crystallised material is being retained.

Columbite and Tantalite.—Approximately 3 tons of tantalite (i.e. material with more than 30 per cent. Ta_2O_5) and 8 tons of columbite were exported in 1943, but in the opinion of the Uganda Geological Survey the potential output of the Protectorate is much greater. Difficulties of working, and in some instances separation from tinstone, still hold up production, but a slow though steady rise has been in evidence throughout 1944. The most promising and productive tantalite mine, Kakanena in Ankole, has been taken over by the Geological Survey, and it is hoped to raise the output to a ton a month. One promising columbite claim has been opened up in Buganda, and the surrounding area gives every promise of yielding more pegmatites of similar mineral content.

Gold.—This still shows a marked decline in output, but with the promise of more assured local food supplies and a minimum replacement of essential machinery and material from the United States, some improvement is hoped for before the end of 1944.

Tin.—Production has been maintained at much the same rate as formerly, despite considerable shortages of labour and food. One or two new but small finds have been made.

Wolfram.—With three discoveries of workable wolfram in the Kawungera area of the Mubende-Kampala road, there are now five claims in Buganda producing the mineral. Four localities in Kigezi are yielding wolfram, including one on the Congo border which entails the draining of a large swamp. Both scheelite and wolfram veins occur in the Mpororo area of Kigezi.

It is stated that labour shortages have considerably reduced the output, especially in the south-west of the Protectorate, during the past year. However, the further statement that 40 tons of wolfram were exported in the first half of 1944 as against 29 tons for the whole of 1943 suggests a rapid rise in the potentialities of Uganda wolfram.

Other Minerals.—Among other minerals, mica production commenced in the Labwor district in September, 1943, and by the end of the year 2,000 lb. of cut mica had been exported. In the first half of 1944 output rose from 1,100 lb. to 2,600 lb. a month. Other discoveries of mica have been made and further discoveries are expected between Labwor and the Sudan border.

Considerable quantities of a talc-like rock, probably pyrophyllite, have been found in a pegmatite 58 miles north-west of Kampala and could be produced cheaply if necessary.

Karroo clays from the neighbourhood of Entebbe, mixed in the proportion of 20 or 30 per cent. with local swamp clay, have proved satisfactory for the manufacture of a pottery body, and production in quantity is now proceeding well.

A feature of special interest revealed by Supplement No. 2 is the extent to which deposits are being operated by the Geological Survey itself, presumably as a wartime measure in special cases where private enterprise is not forthcoming. Reference has already been made to the Department's taking over and working of the tantalite mine at Kakanena.

Some 150 lb. of specially selected quartz crystals won by the Department from Buhwezu were exported during the past year. Likewise 300 tons of copper carbonate concentrates are being produced at Kilembe, in the foothills of the Ruwenzori Mountains, for manufacture into copper sulphate in Kenya. A few hundredweights of high-grade sand was sold by the department to East African firms for specialised purposes. An experimental, independent-feed kiln built near the departmental laboratory has produced a much better lime from the crystalline limestone of the Tororo area than that previously burnt by several authorities and lime workers. The experiments are still proceeding, mainly with the method of firing. Further work on the limestones of the Muhokya area (Ruwenzori) has proved probably over a million tons of first-class limestone and the burning of this rock is about to commence.

A. W. G.

BOOK REVIEWS

Books for review should be addressed to " The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

PRINCIPLES OF PHYSICAL GEOLOGY. By Arthur Holmes, D.Sc., F.R.S. Pp. xii. + 532, 8 × 5½. (London: Thomas Nelson and Sons, Ltd., 1944.) Price 30s.

Professor Holmes is perhaps best known as the writer of standard works on petrology and the age of the earth, so that one's first thought on seeing this volume is apt to be that here the author is breaking new ground. However, in his preface, Professor Holmes tells us that " the method of treatment adopted is one that twenty years' experience has shown to be successful in training students and in holding and developing their interest, even when, as has often been the case, some of them have come to the subject without any preliminary acquaintance with scientific principles and methods." Professor Holmes has always been noted for his facile pen, and in the present instance he has succeeded in producing such a readable book, whether it be from the viewpoint of a geologist or of a person with no special scientific training, that the reader may well envy those who were able to attend the course of lectures on which it is based. While this is essentially a textbook or work of reference it will undoubtedly be read by a much wider public than that which usually consults works on physical geology.

In view of the existence of numerous foreign volumes on physical geology, the appearance of this new British book on the subject is to be welcomed, especially when, in addition to its concise, lucid and readable style, it is so well illustrated by carefully selected photographs and diagrams and so well produced in clear type on good paper. In fact, the general set-up of this volume is equal to that of the best pre-war standards and its appearance after five years of war is a credit to all concerned in its production.

Illustrations are a particularly important matter in a work on physical geology, and the subjects of these illustrations have in the past sometimes tended to be dominated by the nationality of the author, but the present work follows the excellent precept of selection from the best photographs of the finest examples in the world at large.

This work of over 500 pages is divided into three parts. The first, called a preliminary survey, deals with the broad aspects of the shape and surface relief of the earth, the changing face of the earth, the common minerals and rocks forming the crust, the architectural features of the crust, and rocks as the pages of earth history. The second part describes the external processes and their effects, including rock weathering and soils, underground waters, river action and valley development, the development of river systems and associated landforms, glaciation, wind action, coastal scenery and marine erosion, life as a rock builder, concluding with a very interesting chapter on life as a fuel maker, wherein the geology of peat, coal and petroleum is summarised.

Part III, internal processes and their effects, entails consideration of the hidden activities of the earth's interior, a subject on which the author has already published much and is a recognised authority. In this, after reviewing such subjects as earthquakes, mountain building and its causes, earth movements giving rise to large scale areas of elevation or depression, the origin of rift valleys, and volcanic activity and speculations as to its causes, the author concludes with an up-to-date review of the hypothesis of continental drift.

An index is appended, which, in view of the large number of illustrations of classic examples, is made to include reference to these as well. In this particular instance this method is certainly to be preferred to the giving of a list of illustrations of such length as to defeat its purpose.

A. W. G.

PHOSPHATES AND SUPERPHOSPHATE. By A. N. Gray. Second Edition. Pp. 416, 7¼ × 4¾. (London: E. T. Heron & Co., Ltd.; Distributing Agents: H. K. Lewis & Co., Ltd., 1944.) Price 21s.

This is the second edition of a book with a slightly different title, which appeared in 1930 and was reviewed in this BULLETIN, 1931, 29, 267. Supplements bringing the statistics up to date were issued in 1932 and again in 1936.

The present volume closely resembles its forerunner both in its green limp leather binding and in the arrangement of contents, which consist of about 250 pages of text, comprised in 14 chapters, and 150 pages of statistical tables. Comparison with the 1930 edition, however, shows that the non-statistical part of the book has been greatly enlarged as well as considerably rewritten; it also contains 38 illustrations. The first six chapters deal with raw phosphate, the next five with superphosphate, and the last three with other manufactured phosphates, basic slag and phosphoric acid.

In the first chapter there is an estimate of the quantities and percentages of phosphate rock consumed in the world in 1938 for various purposes, which provides an interesting comparison with the figures for 1928 in the first edition. It shows that the percentage used for superphosphate manufacture dropped during the decade from 85·2 to 78·7, while the percentage used as ground phosphate increased from 4·0 to 8·4.

The chronological table of events in the history of raw phosphate production which makes up most of the second chapter has been much improved and largely brought up to date, but the patchiness of the revision is exemplified by the contiguous paragraphs on Transjordania, which is new, and Nigeria, which is unaltered and still records the discovery in that country as having been made three or four years ago. A very short account of methods of winning and dressing raw phosphate has been included, together with a description of the activities of the British Phosphate Commission.

Several more modern complete analyses of raw phosphates from different deposits, as well as a new section on the influence of trace elements on plant growth, have been added to the chapter on grades of phosphate, and a noteworthy addition is the completely new chapter on phosphate deposits and reserves, in which the world's principal phosphate workings are described mainly from the commercial standpoint, and estimates made by various authorities of the reserves available are collected together. In the chapter on consumption, which contains a careful statistical study of this subject, it is shown that although Europe (in which Russia is included) before the war was still by far the largest user of phosphate rock (56·5 per cent. of world production in 1939) it was consuming a decreasing percentage of the total available. The trade in raw phosphate is dealt with in another chapter which provides much useful information about marketing and prices.

The section on superphosphate has been very much extended and greatly improved, for besides the enlargement of the chapters on production, consumption and trade throughout the world, it now contains an account of the methods of manufacture with illustrations and diagrams, and a chapter on the costs of production in various countries. There are also new chapters on other manufactured phosphatic fertilizers, basic slag and phosphoric acid.

The new edition is far superior to the old and particularly praiseworthy for the wealth of thoroughly practical information it contains. It is very readable but suffers from several unnecessary digressions from the theme, such as the account of the spectroscope and its use, the description of mills for fine grinding appended to the subject of consumption of raw phosphate, and the short discourse on hydrogen-ion concentration included among the uses of phosphate rock. It could have been still further improved by judicious rearrangement, but the excellent index is a redeeming feature.

The statistical information is most comprehensive and as up to date as possible, and the book will undoubtedly be of great interest to anyone concerned in the phosphate business.

G. E. H.

COLORIMETRIC DETERMINATION OF TRACES OF METALS. By E. B. Sandell, Ph.D. Pp. xvi + 487, 9 × 6. (New York: Interscience Publishers, Inc., 1944.) Price $7.00.

The importance of trace elements in a great variety of natural and artificial products has become increasingly evident in recent years, and descriptions of colorimetric methods for the determination of these traces have appeared in current technical literature with almost overwhelming frequency. Any analyst who has had much experience of these methods will, however, agree that this fascinating field of inorganic analysis is full of pitfalls for the unwary, and that, although there is something peculiarly satisfying about an elegant and accurate colorimetric method, much preliminary work is often necessary in order to ensure the correct conditions for its application. As the author so rightly points out, "the effect of foreign elements on a particular colour reaction is frequently poorly known, and the prevention of the interference of foreign substances has, for the most part, been incompletely studied." It follows that the analyst, when called upon to develop a colorimetric method, must bear two things in mind—firstly, the separation of the trace element, if this should be necessary, and secondly, the choice of a suitable reagent. Between them, these two factors may demand a considerable degree of analytical skill.

The book is divided into two parts—general and special. The general part (Colorimetric Trace Analysis) gives a general account of the methods available for the separation and isolation of traces, of the fundamental principles of colorimetry and spectrophotometry, and of a number of colorimetric reagents of fairly wide applicability. The special part (Procedures for the Determination of Traces of Metals) is divided very conveniently into chapters dealing with the metals in alphabetical order. Separations, selected methods, and particular applications are described in detail, and many graphs and analytical tables are given.

The author would not claim that he has entirely covered the now extensive field of colorimetric analysis, but the analyst will certainly find in this volume a great wealth of information, and much sound guidance in analytical procedure. He will also find, incidentally, that, judging from the quality of the paper and binding of this book, the " regulation for conserving paper and other essential materials " in the United States is not very stringent.

This admirable work, which forms Volume III of a series of monographs, should make a very wide appeal, and is warmly recommended to all analysts interested in the determination of metallic elements.

L. C. C.

METALLURGICAL ANALYSIS BY MEANS OF THE SPEKKER PHOTO-ELECTRIC ABSORPTIOMETER. By F. W. Haywood, Ph.D., F.I.C., and A. A. R. Wood. Pp. xii + 128, 8¾ × 5¾. (London: Adam Hilger, Limited, 1944.) Price 18*s*.

The scope of inorganic analysis was considerably extended by the introduction of numerous colour reactions for metals, but in order to adopt these reactions to quantitative work it has been necessary to match the colour of the solution under test with a solution of known strength, and until recently the results obtained depended on a visual method of comparison. A high degree of accuracy could not be obtained on account of the inadequacy and variability of the response of the human eye and the interference of other ingredients of the sample under examination. Such methods, although of great value in certain cases, were thus restricted to the determination of traces of elements.

The use of photo-electric cells, with appropriate colour filters, has removed these sources of error and considerably increased the accuracy of colour reactions so that many major constituents of inorganic materials can now be determined in this way. The Spekker Photo-electric Absorptiometer, which is an instrument of this type, is now in use in a number of metallurgical laboratories, and this book gives a working description of the instrument and its accessories with details of the methods of metallurgical analysis to which it has been applied. Separate methods are given for the determination of most of the usual alloying elements in ferrous, copper, aluminium and magnesium alloys and a composite scheme is given in tabular form for each group of alloys.

The majority of the methods included in this book were described by E. J. Vaughan, to whom the authors acknowledge their indebtedness, in two Monographs on " The use of the Spekker Photo-electric Absorptiometer in Metallurgical Analysis," published by the Royal Institute of Chemistry in 1941 and 1942. Other methods have been developed by the authors and described elsewhere in the literature.

In a book of this nature, dealing with a rapidly developing technique, recent publications are of most interest, and it is disappointing to find that some of the more recent papers on this subject are not mentioned. This may be due to unavoidable delays in publication—the preface, for instance, is dated December 1943—

or to the authors' desire to check the work of others before including it in their recommendations. As an example, titan-yellow has proved a valuable reagent for determining magnesium in aluminium and other alloys, and is especially suited to absorptiometric work, but no reference is made in the book to this reagent and the method of employing it described by Stross in *The Analyst*, 1942, **67**, 317.

The authors realise that their subject has great possibilities, and have suggested future lines of advance. With the increased use of instruments of this type many colorimetric methods which have been developed for visual estimation will, with advantage, be adapted to photo-electric measurement.

The price of the book is high, even by present standards, but the quality of the paper and binding is excellent.

W. H. B.

PETROL—ITS DEVELOPMENT, PAST, PRESENT AND FUTURE—WITH SOME NOTES ON THE POTENTIALITIES OF HIGH-OCTANE FUELS FOR ROAD VEHICLES. By H. Fossett. Pp. 42, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Institution of Automobile Engineers, 1944.) Price 4*s*.

This is a reprint of a paper which was published in the May 1944 issue of the Journal of the Institution of Automobile Engineers.

In the course of a brief survey of the development of the oil industry and the collateral expansion of the uses of the internal combustion engine, the author reviews the part played by fuels in the development of the spark-ignition engine. He also discusses the uses of high-octane fuels in road vehicles and forecasts future advances in this direction.

A short account of the petroleum industry is included, in which the processes employed in refining crude petroleum, such as distillation and cracking, are briefly surveyed. The anti-knock properties and responses to tetra-ethyl lead of the various hydrocarbons are considered. The octane scale for assessing the anti-knock value of a fuel is explained, together with the methods of blending used to produce aviation fuels having a high basic anti-knock value and a high response to tetra-ethyl lead.

The total production of high octane fuels is at present required for aviation purposes, but the author envisages the future prospects of the use of such fuels in the automobile field. Their use might be restricted on the grounds of cost, but greater efficiency is possible, either by increasing compression ratios, or by supercharging, or a combination of both, which might offset the extra expense and would effect considerable economies in the use of fuel.

The technical developments of these possibilities are considered in some detail, and the author concludes with some suggestions on related future trends of automobile engine design, such as the hollow-headed, sodium-cooled valve and piston cooling.

There are two appendixes, the first consisting of a table of properties of some representative hydrocarbons, the second being notes on motor fuel specifications.

This paper is particularly addressed to the engine designer, but the sections on future developments in the petrol and automobile industries are of general industrial interest and will appeal to a wider circle of readers.

W. H. B.

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result of breeding and selection [6]. Moreover, according to Goss [3] there is the same preference for the meal of the latter varieties for animal feeding as prevails in the United Kingdom. Furthermore, only the yellow-seeded types are used for the manufacture of edible flour. It has been stated that green, brown and black varieties of soya beans will produce abnormally coloured oils if the seed coat is not removed before processing [6]. It seems to be clear that seed production should be based on yellow-seeded varieties. In this connection it may be noted that the new soya bean strains bred at Potchefstroom, Union of South Africa, are all stated to be yellow-seeded [10].

Utilisation of Soya Beans: *Soya Bean Oil.*—Morse [7] has tabulated in considerable detail the various uses of soya bean products, the most important of which is the oil. Of some 187 million bushels produced in the United States in 1942, approximately 133 million bushels were processed for oil [2], about 71 per cent. of the crop. The balance was used for sowing, feeding livestock, soya flour manufacture, and miscellaneous purposes. In 1940-41, soya beans were processed for oil as to 74·2 per cent. by means of continuous pressing (expellers and screw presses), 2·7 per cent. by hydraulic presses, and 23·1 per cent. by solvent methods [6]. The use of solvent extraction has been gradually expanding. Hydraulic and expeller presses yield approximately 300 lb. of oil and 1,600 lb. of cake per ton (2,000 lb.) of beans treated, the 100 lb. loss being mainly moisture [2].

The following preliminary figures relating to the United States for the factory consumption of soya bean oil in 1943 have been published [1]:

Product manufactured.	Consumption in 1,000 lb.
Compounds and vegetable cooking fats	568,405
Oleomargarine	198,020
Other edible products	124,562
Soap	15,428
Paint and varnish	20,462
Linoleum and oilcloth	273
Printing inks	48
Miscellaneous	33,075
Loss, including oil in foots	94,862
Total factory consumption	1,055,135

As these statistics show, the bulk of the soya bean oil consumed in the United States is used for edible purposes, i.e. vegetable shortenings, margarine, salad and cooking oils. The chief industrial uses appear to be in soap, and in paints and varnishes. The oil is also employed in enamels, linoleum, oilcloth, and printing ink [2]. It would appear that war circumstances are responsible for a reduced current usage in certain industries, e.g. linoleum and oilcloth.

Soya Bean Meal and Protein.—According to a recent publication [2] the chief outlet for soya bean meal is as a concentrated feeding stuff in the livestock industry. Before the war some 95 per cent. of the output may have been so employed. The meal is also used in the food industry, in the manufacture of soya flour and soya grits. In the same publication it is stated that the industrial utilisation of soya bean meal and protein is based primarily on their adhesive properties. The plywood and wall-paper coating industries consume the largest quantities. Soya bean meal is also used in plastics, orchard sprays, and foundry core binders. The refined protein is described as finding application in beater and tub sizing of paper, in sizing for silk hosiery, in water paints, in artificial fibres, and in leather dressings.

Soya Bean Phosphatides.—Soya bean phosphatides, composed chiefly of lecithin and cephalin, are obtained mainly from solvent extracted oil. They can also be prepared from the beans. These substances in the United States find use as wetting agents and anti-oxidants, principally in the confectionery and food industries [2]. They are also employed in pharmacy and cosmetics and have a number of potential uses in industry [6].

Soya Bean Flour.—Soya bean flour may be produced from the whole beans, after removing the seed coats, or from soya bean meal. Recent annual production in the United States has been in the neighbourhood of 25 million pounds. In that country the principal uses of the flour are in the manufacture of sausages, dog food, miscellaneous meat products, and in bakery goods. In the production of bread, it is admixed with wheat flours in varying proportions [6]. Soya beans for flour manufacture are commonly subjected to a " debittering " process to remove their characteristic " beany " flavour.

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Diseases of Vegetables. By L. Ogilvie. *Bull. No.* 123, *Minist. Agric. Lond.* Pp. 74, 9½ × 6. (London: H.M. Stationery Office, 1944.) Price 1*s.* 6*d.*

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Bacterial Proteinase from Waste Asparagus Butts. By L. Kline, L. R. MacDonell and H. Lineweaver. *Industr. Engng. Chem., Industr. Ed.*, 1944, **36**, No. 12, 1152-1161. Describes the use of the juice from waste asparagus butts and trimmings for the production of this product.

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Imperata cylindrica. Taxonomy, Distribution, Economic Significance and Control. *Jt. Publ. No.* 7, *Imp. Agric. Bur.* Pp. 63, 9¾ × 7¼. (Aberystwyth: Imperial Agricultural Bureaux, 1944) Price 2*s.* 6*d.*

Paspalum dilatatum for Autumn Pasture. By J. P. J. van Vuren. *Frmg. S. Afr.*, 1945, **20**, No. 226, 31-32, 40.

Oils and Oil Seeds

Utilisation of Indian Cotton Seed. By D. Y. Athawale. *Indian Frmg.* 1944, **5**, No. 7, 306-308. Concerned chiefly with the production of cotton seed oil.

Storage of Oilcakes. Experiments with Sulphonamide E.O.S. and Propamidine as Preservatives. By D. Snow and P. S. Watts. *Food*, 1945, **14**, No. 160, 16-18. Laboratory trials at high humidities have shown that these drugs have marked inhibitory actions on the growth of moulds on linseed cake.

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By H. R. Sallans, M. Berenbom and R. K. Larmour. *Canad. J. Res.*, 1945, **23,** Sec. F, No. 2, 91-103.

Annual Report of the Tung Experimental Station, Nyasaland, for 1943. Pp. 16, 13 × 8. (Zomba: Department of Agriculture, 1944.)

Fish-Liver Vitamins—Canada and Newfoundland. By M. D. Hall. *Foreign Comm. Wkly.*, 1945, **18,** No. 1, 5-7. A review of the production of fish-liver oils.

Essential Oils

The Essential Oil of *Olearia paniculata.* By D. H. McLean and S. N. Slater. *J. Soc. Chem. Ind. Lond.*, 1945, **64,** No. 1, 28-29. Gives particulars of the constants and composition of oil from the leaves and terminal branchlets.

Manufacture of Sandalwood Oil in India. By S. G. Sastry. *J. Sci. Industr. Res. India*, 1944, **3,** No. 2, 75-78.

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Abacá (Manila Fiber) in the Philippines. By M. E. Wambsganss. *Foreign Comm. Wkly.*, 1944, **17,** No. 13, 8-11, 38. General article on the cultivation, harvesting and uses of the fibre.

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Sunnhemp Fibre Production. By D. H. Fox. *Rhod. Agric. J.*, 1945, **42,** No. 1, 6-13.

Vegetable Proteins and Synthetic Fibres. By D. Traill. *Chem. and Ind., Lond.*, 1945, No. 8, 58-63. Includes an account of the preparation of fibres with special reference to "Ardil," the fibre derived from groundnut protein.

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Some Aspects of Alpha-Cellulose from Wood Pulp. By N. W. Coster and R. Vincent. *Pulp. Pap. Mag., Canada*, 1944, **45,** No. 12, 893-895.

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Annual Report of the Work of the Rubber Research Board, Ceylon, in 1943. Pp. 34, 9½ × 6. (Colombo: Rubber Research Board, 1944.)

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Cultivation and Breeding of Russian Rubber-bearing Plants. Pp. 57, 13 × 8. (Penglais, Aberystwyth: Imperial Agricultural Bureaux, Central Sales Branch, 1944.) Price 2*s.* 6*d.* Prepared by the Imperial Bureaux of Plant Breeding and Genetics, Cambridge, and Horticulture and Plantation Crops, East Malling, Kent.

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Growing and Curing Flue-cured Tobacco in Central Province, Kenya. By N. D. Spranger. *E. Afr. Agric. J.*, 1945, **10,** No. 3, 140-146.

The Culture of Turkish Tobacco in Southern Rhodesia. *Rhod. Agric. J.*, 1945, **42,** No. 1, 53-75.

Drugs

The Arecanut in Ceylon. By W. Molegode. *Trop. Agric., Ceylon*, 1944, **100,** No. 2, 102-105. Deals with varieties, propagation and planting, yields and uses.

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Biological Assay of Digitalis. By J. B. Swan. *N.Z. J. Sci. Tech.*, 1945, **26**, Sec. B, No. 4, 163-174.

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Sugars from Wood. Review of Processes in the United States Prior to World War II. By E. C. Sherrard and F. W. Kressman. Development of the Scholler Process in the United States. By W. L. Faith. Hydrolysis of Wood. By E. E. Harris, E. Beglinger, G. J. Hajny and E. C. Sherrard. Saccharification of Agricultural Residues. By J. W. Dunning and E. C. Lathrop. Fodder Yeast from Wood Sugar. By W. H. Peterson, J. F. Snell and W. C. Frazier. Rotary Digester in Wood Saccharification. By R. H. Plow *et al.* Kinetics of Wood Saccharification. By J. F. Saeman. By-Products of Wood Saccharification. By R. L. Hasche. *Industr. Engng. Chem., Industr. Ed.*, 1945, **37**, No. 1, 4-54. A symposium on the conversion of cellulosic waste for the manufacture of alcohol and observations on the nature of the problems confronting the industrial development of wood saccharification.

Allyl Ether of Starch. Preparation and Industrial Possibilities. By P. L. Nichols *et al.* *Industr. Engng. Chem., Industr. Ed.*, 1945, **37**, No. 2, 201-202.

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Report on the Department of Animal Health, Gold Coast, for 1943-44. Pp. 5, 13 × 8. (Accra: Government Printing Department, 1944.) Price 1*s.*

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Lamb and Mutton Production. General Survey of Breeding Policies. By L. L. Roux, D. J. Engela and S. W. Bosman. *Frmg. S. Afr.*, 1945, **20**, No. 227, 71-80.

Some Common Breeds of Goats in India. II. By S. K. Sen. *Indian Frmg.*, 1944, **5**, No. 8, 356-358.

Meat Dehydration. A Report of Research Work for its Commercial Development. *Circ. No. 706, U.S. Dep. Agric.* Pp. 46, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1944.) Price 10 cents.

The Dairy Industry in New Zealand. By W. M. Hamilton. *Bull. No. 89, Coun. Sci. Industr. Res. N.Z.* Pp. 176, 9½ × 6. (Wellington, N.Z.: Government Printer, 1944.) Price 2*s.* 6*d.*

The Production of First Grade Cream. *Rhod. Agric. J.*, 1945, **42**, No. 1, 88-102.

Distribution of Riboflavin in Fresh and Processed Fish. By W. S. Hoar and M. Barbarie. *Canad. J. Res.*, 1945, **23**, Sec. E, No. 1, 8-18.

Some of the Principles Involved in the Smoke Curing of Fish. By J. M. Shewan. *Chem. and Ind., Lond.*, 1945, No. 13, 98-101.

Some Practical Aspects of Fish Smoking. By C. L. Cutting. *Chem. and Ind., Lond.*, 1945, No. 9, 66-69.

South African Fish Products. Part X. Some Sparid Fishes of the Cape. By J. H. Corbett, W. S. Rapson, H. M. Schwartz and N. J. van Rensburg. Part XI. The Kabeljow (*Sciaena hololepidota* Lacip.), the Geelbek (*Atractoscion aequidens* C. and V.) and the Beardman (*Umbrina capensis* Pappe). By W. S. Rapson, H. M. Schwartz and N. J. van Rensburg. *J. Soc. Chem. Ind., Lond.*, 1945, **64**, No. 1, 5-11.

Vitamins in Spray-dried Eggs. By E. M. Cruickshank, E. Kodicek and Y. L. Wang. *J. Soc. Chem. Ind., Lond.*, 1945, **64**, No. 1, 15-17.

The Fundamental Structure of Hides, Skins and Leather. By G. O. Conabeare. *J. Int. Soc. Leath. Tr. Chem.*, 1944, **28**, No. 12, 270-280.

FORESTRY

General

Annual Report of the Imperial Forestry Institute, University of Oxford, for 1943-44. Pp. 12, 8½ × 5½. (Oxford: Imperial Forestry Institute, 1944.)

Annual Report of the Forests Commission of Victoria, Australia, for 1943-44. Pp. 35, 13 × 8. (Melbourne: Government Printer, 1944.) Price 1*s*. 3*d*.

Report of the Director of Forests, Queensland, for the year ended June 30, 1944. Pp. 3, 13 × 8. (Brisbane: Government Printer, 1944.)

Report of the Forests Department, Western Australia, for the year ended June 30, 1944. Pp. 12, 13 × 8. (Perth: Government Printer, 1944.)

Report on the Forestry Department, Gold Coast Colony, for 1943-44. Pp. 6, 13 × 8. (Accra: Publications Branch, Government Printing Office, 1944.) Price 1*s*.

Report on Forest Administration in Jammu and Kashmir for the half year ending Chet 1998 and the year 1999 (1942, 1943). Pp. 77, 9¾ × 6¼. (Jammu: Ranbir Government Press, 1944.)

Annual Report of the Forest Department, Mauritius, for 1943. Pp. 11, 9½ × 6. (Port Louis: Government Printer, 1944.) Price 50 cents.

Annual Report on the Forest Administration of Nigeria for 1943. Pp. 36, 9½ × 6¼. (Lagos: Government Printer, 1944.) Price 2*s*.

The Forest Resources of Chile. By P. A. Briegleb and I. T. Haig. *Agric. in Americas*, 1944, **4**, No. 12, 223-226, 234-235.

Utilization of Forests. Saving Trees by Rendering Utilization more Complete. By T. L. Wilkinson. *Rhod. Agric. J.*, 1944, **41**, No. 6, 398-406.

Bamboo Culture in the Americas. By F. A. McClure. *Agric. in Americas*, 1945, **5**, No. 1, 3-7, 15-16.

Notes on the Growing of Cypress Timber on Farms. By R. M. Graham. *E. Afr. Agric. J.*, 1945, **10**, No. 3, 132-139. Has special reference to East Africa.

Timber

Wood-boring Insects in South Africa. Preventive and Remedial Measures. By F. G. C. Tooke and M. H. Scott. *Bull. No. 247, Dep. Agric. Un. S. Afr.* Pp. 37, 9½ × 6. (Pretoria: Government Printer, 1944.) Price 6*d*.

Wood Flooring. The Preparation, Laying, Finishing and Properties of the Various Types of Wood Flooring. Pp. 37, 7½ × 4¾. (London: Timber Development Association, Ltd., 1944.)

Resins

Determination of Volatile Matter in Lac. By B. S. Gidvani and N. R. Kamath. *Bull. No. 7, Lond. Shellac Res. Bur.* Pp. 23, 8½ × 5½. (London: India House, 1945.)

A Process for the Manufacture of Dewaxed Lac. By B. S. Gidvani and N. R. Kamath. *Tech. Pap. No.* 26, *Lond. Shellac Res. Bur.* Pp. 26, 8½ × 5½. (London: India House, 1945.)

Tanning Materials

Tannin Extract from Western Hemlock Bark. By E. F. Potter, K. T. Williams, T. L. Swenson and I. C. Fenstel. *Industr. Engng. Chem., Industr. Ed.*, 1944, **36**, No. 12, 1146-1149.

IMPERIAL INSTITUTE

CONSULTATIVE COMMITTEE ON INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

QUARTERLY BIBLIOGRAPHY OF INSECTICIDE MATERIALS OF VEGETABLE ORIGIN, NO. 30

(January to March 1945)

Compiled by MISS R. M. JOHNSON

With the collaboration of the Imperial Institute of Entomology and the Department of Insecticides and Fungicides, Rothamsted Experimental Station.

GENERAL

Ann. Rep. E. Malling Res. Sta., 1943. Refers to the use of nicotine for the control of woolly aphis (p. 25), apple sawfly and bean aphis (pp. 27 and 62), tortrix moth (p. 59), gooseberry sawfly, pear and cherry slugworm (p. 62), hop capsid bug but not against capsid bug (p. 63), strawberry aphid (p. 89): nicotine five times as toxic as a preparation of the mixed alkaloids of *Anabasis aphylla* against *Aphis pomi* (p. 26): derris or pyrethrum spray against gooseberry sawfly (p. 62), derris against the slugworm (p. 62).

Ann. Rep. Minist. Agric., Canada, 1943-44. In the Section on the Division of Entomology reference made to tests on nicotine sulphate and rotenone sprays for controlling aphids on potatoes (p. 59): derris dusts the specific for controlling the pea aphid (p. 59): nicotine a likely substitute for derris against the European corn borer (p. 60): derris-talc dust the most effective material for dealing with the striped cucumber beetle (p. 60): nicotine sulphate in summer oil emulsion continued to give best results in the control of the apple sawfly (p. 63): effectiveness of pyrethrum extract as a biting fly repellent (p. 70).

Ann. Rep. Dep. Agric. Mauritius, 1943. Tests carried out with derris against caterpillars and aphids on cabbages gave satisfactory results: planting of derris to be encouraged: locally prepared petroleum-pyrethrum spray proving very satisfactory.

Ann. Rep. E. Afr. Industr. Res. Brd., 1943. Refers to the manufacture of pyrethrum extract and nicotine sulphate in E. Africa.

Bull. No. 420, *Maine Agric. Exp. Sta.* Report of Progress for the year ending June 30, 1943. (*R.A.E.*, 1945, **33**, A, Pt. 1, 2.) Sprays and dusts containing derris were tested on potatoes against *Myzus persicae, Aphis rhamni, Macrosiphum solanifolii* and *M. solani* which are the insects concerned in the transmission of leaf-roll: in experiments on the control of the Mexican bean beetle plots were dusted with pyrethrum and with derris but little increase in yield obtained: pyrethrum was tested for the control of the blueberry fruit fly.

Experiment Stations Report on 1943 Insecticide Studies. A Review of the Latest Reports on Agricultural Insecticide Research by a Group of State Experiment Stations. By H. H. Slawson. *Soap*, 1944, **20**, No. 12, 122-125, 135-137.

War-time Agricultural Research. *Contrib. No.* 650, *Rhode Island Agric. Exp. Sta.*, 1944. Rotenone dust gave control of flea beetles and nicotine spray of aphids on potato foliage, pp. 23 and 24.

Plant Introduction [into Fiji] 1933-1943. By B. E. V. Parham. *Agric. J. Fiji*, 1944, **15**, No. 4, 94-104. Pyrethrum not successful; Turkestan tobacco (*Nicotiana rustica*, and *N. sparata*) tried and proved successful; a strain of Derris from Amani now established and being propagated for distribution.

A Comparison of Derris and Fixed Nicotine in Controlling the European Corn Borer by Spraying in Sweet Corn. By H. B. Wressell. *Ann. Rep. Ento. Soc., Ontario*, 1943, 15-18. Basing the results obtained on ear count alone and conducting the experiment on a commercial scale it was shown that derris was superior to a commercial fixed nicotine spray, under Ontario conditions.

A New Pest on Black Willow in Quebec. By J. Duncan. *Ann. Rep. Ento. Soc. Ontario*, 1943, 48. Derris gave a fair measure of control of *Gastroidea cyanea* Melsh compared with pyrethrum.

Controlling the Fruitworm on Blueberries. By R. Hutson. *Michigan Sta. Quart. Bull.*, 1944, **26**, No. 4, 283-284. (*Exp. Sta. Rec.*, 1944, **91**, No. 5, 571.) Summer oil and fixed nicotine or rotenone reduced the number of infected berries.

Control of *Meligethes aeneus* F. by Chemical Means. By H. Blunck and E. Meyer. *Anz. Schädlingskunde*, 1941, **17**, 102-107. (*Amer. Chem. Absts.*, 1944, **38**, No. 10, 2440.) Dusting with rotenone, pyrethrum or nicotine is effective.

Biology and Control of Berry Moth in the Erie Grape Belt. By B. D. Gleissner. *Bull. No.* 451, *Pennsylvania Agric. Exp. Sta.*, 1943. (*Amer. Chem. Absts.*, 1944, **38**, No. 22, 6472.) Nicotine sulphate proved more effective than pyrethrum or pyrethrum-rotenone extract for the control of the grape leaf hopper but decreasingly effective against the grape berry moth.

Terpene Ethers in Pyrethrum and Rotenone Fly Sprays. By R. L. Pierpont. *Bull. No.* 217, *Delaware Agric. Exp. Sta.*, 1939. (*Brit. Chem. and Phys. Absts.*, 1944, BIII, December, 267.)

The Sensitivity of the Silkworm to Derris and Pyrethrum Dust Mixtures. By J. J. Fransen. *Tijdschr. PlZiekt.*, 1943, **49**, 126-129. (*Amer. Chem. Absts.*, 1944, **38**, No. 22, 6402.)

Ox Warble Fly in India. By B. N. Soni and M. A. Khan. *Indian Frmg.*, 1944, **5**, No. 3, 118-121. Tobacco-lime infusion or derris soap most suitable dressings.

The Constitution and Toxic Action of Natural and Modern Synthetic Insecticides. By P. Lauger, H. Martin and P. Muller. *Helv. Chim. Acta.*, 1944, **27**, 892-928. (*J. Soc. Dy. Col. Bradford*, 1945, **61**, No. 2, 49-51.)

Insecticidal Sprays and Flying Insects. By W. A. L. David. *Nature*, 1945, **155**, No. 3929, 205.

Insect Repellency Testing. Testing of Fabrics and Papers for Attractiveness to Thysanura and Roaches before and after Deterrent Applications. By H. Sweetman, C. L. Warner and B. J. Hershberg. *Soap*, 1945, **28**, No. 3, 104-107, 127, 129, 131.

Soil Insecticides. By H. C. Gough. *Chem. and Ind., Lond.*, 1945, No. 7, 50-53. Pyrethrum, derris and nicotine are of little use in the soil.

Synergist for Insecticides. *Soap*, 1945, **28**, No. 3, 146. U.S. Pat. No. 2,347,265. To an insecticide containing pyrethrum and rotenone as toxicants is added as a promoter 10 per cent. by volume of methylated naphthalene-rich oil, the latter containing at least 70 per cent. by volume of methylated naphthalene.

Safer Handling of Economic Poisons. By A. J. Cox. *Soap*, 1944, **20,** No. 12, 115-121, 139.

ALKALOID-CONTAINING MATERIALS

Tobacco Products, including Nicotine and Nicotine Derivatives

Tobacco Insecticides. By B. Krishna Swamy and N. V. Subba Rao. *J. Indian Chem. Soc., Industr. and News Ed.*, 1944, **7,** No. 2, 99-102.

Some Insect Pests of Ornamental Plants. By G. W. Underhill. *Bull. No.* 349, *Virginia Agric. Exp. Sta.*, 1943. (*R.A.E.*, 1944, **32,** A, Pt. 12, 401-403.) Fixed nicotine spray recommended for control of *Rhyacionia frustrana, Unaspis euonymi, Argyresthia thuiella, Psyllabuxi* and *Phytomyza ilicicola.*

Tobacco Extract for Control of Arsenic-Resistant Blue Tick and Cattle Lice. By P. M. Bekker. *Frmg. S. Afr.*, 1944, **19,** No. 225, 775-780.

Codling Moth Control: Use of Nicotine to Destroy the Moth Stage. By W. S. Hough. *Amer. Fruit Grower*, 1944, **64,** No. 4, 8, 26. (*Exp. Sta. Rec.*, 1944, **91,** No. 5, 570.)

Disease and Insect Control on Hops. By R. O. Magie. *Bull. No.* 708, *N.Y. St. Agric. Exp. Sta.*, 1944. Nicotine sulphate is added to bordeaux-sulphur mixture to control aphids and is also employed for controlling sooty mold.

The Present Status of Citrus Thrips Control. By C. A. Persing and L. R. Brown. *Calif. Citrog.*, 1944, **29,** No. 6, 149, 160-161. (*Exp. Sta. Rec.*, 1944, **91,** No. 6, 718.) Nicotine compounds have given some success.

Pecan Nut Casebearer Control. By H. Hinrichs, G. A. Bierberdorf and F. B. Cross. *Amer. Soc. Hort., Sci. Proc.*, 1944, **44,** 123-128. (*Exp. Sta. Rec.*, 1945, **92,** No. 1, 90.) Lead arsenate and nicotine sulphate spray proved effective.

Pear Psylla Control in British Columbia as an International Project. By W. N. Keenan. *Ann. Rep. Ento. Soc. Ontario*, 1943, 45-46. Nicotine-oil sprays effective.

Biology and Control of the Pear Gall Gnat [*Contarinia pyrivora*]. By P. Bovien and C. Stapel. *Tids. Planteavl*, 1943, **47,** 600-619. (*Amer. Chem. Absts.*, 1944, **38,** No. 22, 6474). Spraying with 0.1 per cent. nicotine with or without Bordeaux mixture effective.

El Pugon Amarillo (*Sipha flava*). By K. J. Hayward. *Circ. No.* 125, *Tucuman Estac. Exp. Agric.*, 1944. (*Int. Sug. J.*, 1945, **47,** No. 555, 63.) Nicotine sulphate effective in dealing with this aphid of the sugar cane in Argentina.

Chicken Louse Control. By H. S. Telford. *Soap*, 1944, **20,** No. 8, 113, 139. Compares the efficacy of DDT, nicotine and sodium fluoride in pyrophyllite.

En för Sverige ny bladlus på päronträd. By J. Muhlow. *Växtskyddsnotiser*, 1944, No. 4, 60-61. (*R.A.E.*, 1945, **33,** A, Pt. 2, 36.) *Anuraphis piri* a pest on pear trees effectively controlled with nicotine spray.

Leaf-Curl Disease of Tobacco in India. By Hem Singh-Pruthi. *Indian Frmg.*, 1944, **5,** No. 5, 220-223. Of the two insecticides tested against the whitefly (the vector of the disease) resin compound seemed to give better results than nicotine sulphate.

Use of Waste Tobacco in Dips. By P. M. Bekker. *Frmg. S. Afr.*, 1945, **20,** No. 226, 25-29.

Nicotine Sulphate Made in India. *Chem. Tr. J.*, 1945, **116,** No. 3007, 22. Utilizes tobacco waste.

INSECTICIDE MATERIALS CONTAINING ROTENONE AND ALLIED SUBSTANCES

General

Latin America as a Source of Rotenone. By E. N. Bressman. *Soap*, 1944, **20,** No. 9, 101-103, 129, 131.

Dispersants for Rotenone. The Importance of Selection of the Most Efficient Dispersant as a Factor in Toxicity of Rotenone Dusts. By R. L. Janes and H. F. Wilson. *Soap*, 1944, **20,** No. 9, 107, 109, 111.

Influence of Temperature on Insecticidal Power of Rotenone Powders. By J. Feytaud. *Compt. Rend. Acad. Agric. France*, 1940, **26,** 408-412. (*Brit. Chem. and Phys. Absts.*, 1944, BIII, December, 251.)

Tests Indicate Several Materials can be used for Control of Mexican Bean Beetle. By G. M. List. *Colorado Farm Bull.*, 1944, **6,** No. 3, 11-13. (*Exp. Sta. Rec.*, 1944, **91,** No. 5, 569.) Various insecticidal materials, including rotenone, were compared.

Insecticide Powder. U.S. Pat. No. 2,326,297. *Soap*, 1944, **20,** No. 9, 117. A rotenone product dissolved in a phenol-aldehyde condensation product.

Derris

Derris Grows in America. By R. H. Moore. *Agric. in Americas*, 1945, **5,** No. 1, 10-12, 16, 18.

Ann. Rep. Dep. Agric. Fiji, 1943. *Agric. J. Fiji*, 1944, **15,** No. 3, 70. Refers to high content of active principles of derris grown experimentally at the General Experiment Station, Sigatoka.

Derris. *Mthly. Bull. Tanganyika Econ. Control Brd.*, 1944, No. 6, 3. Particulars of prices at which Ministry of Supply purchased East African derris in 1944.

Derris [in Zanzibar]. *Ann. Rep. Kizimbani Exp. Sta. Dep. Agric.*, 1943. Brief reference to an increase in the experimental plantings.

The Relationship of the Diameter of *Derris* Roots to the Rotenone Content. By G. T. Bray. *J. Soc. Chem. Ind., Lond.*, 1944, **63,** No. 12, 384.

The Stability of Derris in Insecticidal Dusts. The Solvent-Powder Effect. By R. S. Cahn, R. F. Phipers and E. Brodaty. *J. Soc. Chem. Ind.*, 1945, **64,** No. 2, 33.

Derris Agronomy: An Annotated Bibliography and a Critical Review. By R. E. Moreau. Parts I and II, *E. Afr. Agric. J.*, 1944, **10,** No. 2, 75-82; 1945, **10,** No. 3, 168-176.

Lonchocarpus

European Corn Borer Attacks Gladiolus. By M. D. Farrar. *Gladiolus Supp.* (*New England Gladiolus Soc.*), 1944, **8,** No. 1, 21-23. (*Exp. Sta. Rec.*, 1944, **91,** No. 5, 571.) Powdered cube root in summer oil emulsion gave the most promise of control.

Others

Da raiz de *Tephrosia toxicaria* Pers. e do sue aproveitamento no combate ao *Tenthecoris bicolor* Scott. By P. Occhioni. *Rodriguésia*, 1943, **7,** No. 16, 55-61. (*Exp. Sta. Rec.*, 1944, **91,** No. 6, 710.) The root of *T. toxicaria* and its value in combating this leaf bug.

PYRETHRIN-CONTAINING MATERIALS

The Structure of Pyrethrolone and Related Compounds. Part II. By T. F. West. *J. Chem. Soc.*, 1944, Dec., 642.

Nitromethane in Pyrethrin Extraction. *Chem. Tr. J.*, 1944, **115,** No. 3006, 691.

The Relative Resistance of *Periplaneta americana* and *Blatella germanica* to Pyrethrum Spray. By E. R. McGovran, J. H. Fales and P. G. Piquett. *Pests*, 1944, **12,** No. 4, 12-13. (*Exp. Sta. Rec.*, 1944, **91,** No. 6, 710.)

Roach Control Tests. By G. E. Gould. *Soap*, 1945, **21,** No. 2, 113-115, 121. Tests included the use of pyrethrum marc mixed with other materials.

Fly Control in Dairy Barns. By F. W. A. Atkeson, A. O. Shaw, R. C.

Smoth and A. R. Borgmann. *J. Dairy Sci.*, 1943, **26**, 219-232. (*Brit. Absts.*, 1945, BIII, Feb., 52). Sprays containing pyrethrum satisfactory.

Mosquito Oils, Larvicides, Repellents, Outdoor Sprays and their Application. By J. M. Ginsburg. *Bull. No.* 711, *New Jersey Agric. Exp. Sta.*, 1944. (*Exp. Sta. Rec.*, 1944, **91**, No. 5, 574.) Pyrethrum referred to as mosquito larvicide.

Miride du Cottonier *Creontiades pallidus* Ramb. By D. Soyer. *Publ. Inst. Nat. Étude Agron. Congo Belge, Sér. Sci.* No. 29, 1942. (*R.A.E.*, 1944, **32**, A, Pt. 12, 415-416.) In experiments on control dusts of pyrethrum were of no value.

Rapport sur les Exercices 1940 et 1941, Institut National pour l'Étude Agronomique du Congo Belge. (*R.A.E.*, 1944, **32**, A, Pt. 12, 416-417.) In work on the control of *Helopeltis orophila* pyrethrum dusts gave the best results and a dust of pyrethrum in wood ashes is recommended for the control of *Deilephila neru.*

Some Experiments with the Pyrethrum Aerosol under Canadian Conditions. By H. A. U. Monro, L. J. Briand, R. Delisle and C. C. Smith. *Ann. Rept. Ento. Soc. Ontario*, 1943, 42-45.

Clonal Strains of Pyrethrum. By B. D. Erain, W. A. Simanton and A. C. Miller. *Proc. Amer. Soc. Hort. Sci.*, 1944, **44**, 521-524. (*Brit. Absts.*, B.III, Jan., 11.)

Pyrethrum Culture. Notes on Experiments with Pyrethrum Grown on Soil and in Culture Solution. By J. S. Yip. *Soap*, 1945, **21**, No. 2, 117-119.

Pyrethrum in Brazil. *Chem. Engng. News*, 1944, **22**, No. 24, 2237. Seed supplied by U.S.A. being grown in Sao Paulo and Campos do Jordao.

Pyrethrum Cultivation Undertaken in Colombia. *Foreign Comm. Wkly.*, 1945, **18**, No. 6, 28.

Pyrethrum Production in Tanganyika. *Public Ledger*, 1945, No. 33,736, 1. Area under pyrethrum 5,300 acres.

Pyrethrum in Travancore. *Chem. Tr. J.*, 1945, **116**, No. 3013, 185. Cultivation being encouraged.

OTHER INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

Acorus calamus—the Sweet Flag—a New Indigenous Insecticide for the Household. By T. V. Subrahmanyam. *Indian J. Ent.*, 1942, **4**, Pt. 2, 238. (*R.A.E.*, 1944, **32**, B, Pt. 12, 223.) Useful against clothes moths, bed bugs and lice on fowls.

How to make wood unpalatable to the West Indian Dry-wood Termite, *Cryptotermes brevis* Walker. II. With Organic Compounds. By G. N. Wolcott. *U.S. Dep. Agric., For. Serv., Caribbean Forester*, 1944, **5**, No. 4, 171-180. (*Exp. Sta. Rec.*, 1945, **92**, No. 1, 91.) Cedar oil and crude cashew nut shell oil at 5 per cent. strength proved permanently repellent.

Tests of Repelling Agents for the Nun Moth Caterpillar in 1938. By H. von Zehmen. *Anz. Schädlingsk.*, 1942, **18**, 137-139. (*Amer. Chem. Absts.*, 1944, **38**, No. 22, 6472.) Strongly repellent materials were heliotropine and terpineol : perceptibly repellent were coumarin, isosaffrol and guiacum wood oil.

New Deterrent Substances for Protecting Man against Attacks of Mosquitoes. By D. I. Blagoveshchensky, N. G. Brevetova and A. S. Monchadsky. *C. R. Acad. Sci. U.R.S.S.* (*N.S.*), 1943, **40**, No. 3, 119-122. (*R.A.E.*, 1945, **33**, B, Pt. 2, 15.) Experiments in Tadzhikistan showed that d-α-pinene is an efficient substitute for turpentine : obtained as a waste product in the process of purification of juniper oil from *Juniperus seravscharica.*

BOOK REVIEWS

Books for review should be addressed to "The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

A TEXT-BOOK OF PHARMACOGNOSY. By George Edward Trease, B.Pharm., Ph.C., F.R.I.C., F.L.S. Fourth Edition. Pp. viii + 799, 8½ × 5½. (London: Baillière, Tindall & Cox, 1945.) Price 27*s.* 6*d.*

The necessity for publishing within a period of just over ten years four editions of a text-book on a scientific subject is surely an indication of the demand, springing from appreciation, for that book. Such is the case of Trease's work on Pharmacognosy.

The previous edition was published in November 1938 (see this BULLETIN, 1939, **37**, 81). Since that date advances have been made in pharmacology and additions have had to be made to the drugs and allied materials employed, for example penicillin. References to recent materials have been included in the new edition of this text-book. The main alterations that the author has made in revising his work are in the arrangement of the subject matter, a fuller treatment of the constituents of drugs, and greater attention to microscopy. This has entailed the re-writing of some sections.

The book opens with several chapters dealing with general principles, including the cultivation of medicinal plants, the collection, drying and storage of drugs, and the insect and other pests liable to attack these materials. Parts II and III, which form the larger part of the volume, are devoted to drugs of vegetable and animal origin. Information is given regarding their source, collection, preparation, characters, constituents, uses and chemical tests. The drugs are arranged according to the system of Rendle, under the different phyla from which they are obtained. Part IV, headed Chemistry, deals with the constituents of drugs, their extraction, evaluation and analysis by fluorescence and chromatographic methods. The last part, on microscopy, contains chapters on cell structure, cell contents and the microscopical study and examination of drugs.

This new edition possesses features which are an improvement upon those in the previous one. Among these may be mentioned the transference of the part dealing with microscopy to the end of the book which enables the detailed description of the drugs to follow the natural sequence and take a place immediately after the part devoted to general principles. The high quality of production has been continued. Many new illustrations have been included, and in this respect special mention must be made of those showing sections of the drugs.

The author and his collaborators are to be congratulated upon this new edition, which maintains the high standard of previous ones. According to the preface to the first edition, this text-book was written for "students reading for pharmaceutical examinations in most English-speaking countries." It definitely meets this requirement but at the same time it cannot fail to be of considerable value to a large number of chemists, both pharmaceutical and analytical, whose work entails a knowledge of drugs.

G. T. B.

PRINCIPLES AND METHODS IN THE CANNING OF FISHERY PRODUCTS. By Norman D. Jarvis. United States Department of the Interior, Fish and Wildlife Service, Research Report No. 7. Pp. vii + 366, 9 × 6. (Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, 1943.)

Though some methods of preserving food, such as drying, smoking, salting and pickling, have been practised from time immemorial, and in more recent years refrigeration has played an important part in attaining the same end, canning is the method that has done most to make a large variety of foods readily marketable and conveniently available to consumers at distances remote from the places in which they are produced.

The history of food canning begins at the time of the Napoleonic era, since when it has made rapid strides. Fishery products were among those first canned. Early progress was largely by trial and error, but, to quote the introduction to this Report, "to-day the industry must depend on scientific study of the principles on which preservation by heat in hermetically sealed containers is based, for the maintenance and extension of its wide market and its ability to sell a product of standard and dependable quality."

The Report deals not only with these scientific principles, but also with factors to be considered in establishing a cannery, different types of containers, methods of packing and sealing, and various engineering problems involved. It gives accounts of the methods used in the fishing, treatment and commercial canning of a large number of individual products including salmon, sardines, tuna, mackerel, alewives, eels, haddock, herrings, shad and sturgeon, as well as various shellfish and crustacea. Further chapters deal with "specialty products" containing other ingredients besides fish, ranging from clam chowder to turtle soup; with fish roe and caviare; with canned products hermetically sealed but not sterilized by heat (and therefore only preservable for limited periods) such as anchovies and smoked salmon; with spoilage, laboratory examination, cannery inspection, and the nutritive values of canned fishery products.

The amount of hitherto unassembled information brought together in this publication makes it a valuable work of reference for all concerned with food technology and with the products of the fishing industry in particular.

F. F.

WOOD CHEMISTRY. Edited by Louis E. Wise. Pp. x + 900, 9 × 6. (New York: Reinhold Publishing Corporation, 1944.) Price $11.50.

There are fourteen contributing authors to this volume which is under the editorship of Professor L. E. Wise. The title, *Wood Chemistry*, is not sufficiently comprehensive to cover all the subjects handled in this treatise, for although the chemistry of wood is very fully treated, there are admirable sections of the book dealing with the growth, anatomy and physical properties of wood. In Part II, devoted to the components and chemistry of the cell wall, our present-day knowledge of cellulose in all its aspects is well recorded. In further sections extraneous components of wood, and the surface properties of cellulosic materials, are discussed. The chemical analysis of wood forms an important part of the volume, and the final section, Part VI, deals with the combustion of wood, thermal decomposition, delignification and the decomposition of cellulose by micro-organisms.

This volume, which is well provided with references to literature, is a valuable addition to the American Chemical Society's Series of Scientific and Technologic Monographs, to which it belongs. Its value will be as a reference authority on the subjects mentioned above, which though comprehensive are well contained within its 900 pages.

J. R. F.

TROPICAL FRUITS FOR SOUTHERN FLORIDA AND CUBA AND THEIR USES. By David Sturrock. Pp. 131, 9 × 6. (Arnold Arboretum of Harvard University, Jamaica Plain, Mass., U.S.A., 1940.)

This booklet has been issued to describe the wide variety of tropical fruits that can be grown in the localities indicated in its title. It is written especially as a popular guide for the private gardener, and is particularly related to cultural conditions in Southern Florida. The author, who is Superintendent of the Atkins Institution of the Arnold Arboretum of Harvard University, Soledad, Cienfuegos, Cuba, is anxious that residents should be fully informed concerning the range of such fruits as they may cultivate. He has succeeded in producing a readable account of his subject, one of the chief merits of which is that it brings together in a small compass many useful practical details.

The work will be appreciated by those interested in growing tropical fruits in other countries. Study of its pages serves to remind the reader of the large number of these that have some, even if limited, domestic use, and should be available at least in experimental gardens. Furthermore, the cultural particulars will by analogy be of value to planters outside the regions with respect to the conditions in which they have been actually written.

E. H. G. S.

BULLETIN
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PLANT AND ANIMAL PRODUCTS

REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the Reports made to the Dominion, Indian and Colonial Governments

SUNFLOWER SEED FROM NIGERIA

By G. T. Bray, F.R.I.C., and F. Major, B.Sc., A.R.I.C.

Sunflower seed is grown in several countries for the production of oil. The country which produces the largest quantity of this seed is Russia, the amount harvested in that country in 1938 being estimated at over 1½ million tons. Next in importance are the Argentine, with 265,000 tons, and Roumania, with 227,000 tons. Bulgaria, Hungary and Jugoslavia are also large producers. In the British Empire, no considerable quantities have been produced although cultivation on a small scale has been started in some countries.

Recently attention has been given in Nigeria to the experimental cultivation of sunflowers. This crop was tried in 1943 by the Agricultural Department on Moor Plantation, and the plants grew extremely well. Since then, it is understood, trials have been made in other parts of the Colony.

Two samples of sunflower seed grown on Moor Plantation in 1943 were received at the Imperial Institute from the Director of Agriculture, and examined with a view to assessing their commercial value. The samples were: (A) Grey seed: large, creamy-white seeds striped with grey, and (B) Black seed: small, dark reddish-brown seeds. On examination, the following results were obtained :

		Grey seed.	Black seed.
Weight of 100 seeds	*grams*	13·3	6·3
Kernels in seeds	*per cent.*	50·5	47·3
Husk in seeds	"	49·5	52·7
Moisture in seeds	"	8·5	8·6
Oil in seeds, as received . . .	"	22·5	24·2
Oil in moisture-free seeds . . .	"	24·6	26·5
Oil in kernels, as received . . .	"	44·6	51·2

The oil obtained by extraction of the undecorticated grey seeds with light petroleum was pale golden yellow and deposited stearine on standing, while that from the black seed was similar but slightly paler in colour.

The two oils on examination gave the following results, which are shown in comparison with the figures recorded for sunflower seed oil :

	Present Samples.		Usual figures for Sunflower seed oil.	
	Grey seed.	Black seed.	(1) Unspecified.	(2) Black seed.
Specific gravity at 15/15° C.	0·9201	0·9227	0·922 to 0·926	0·924 to 0·926
Refractive index at 40° C.	1·4656	1·4666	1·4663 to 1·4684	1·4659 to 1·4682
Acid value . . .	7·3	2·7	—	1·0 to 10·0
Saponification value .	188·7	190·8	189 to 194	190 to 194
Iodine value . . .	110·5*	119·7*	120 to 136	125 to 140
Unsaponifiable matter *per cent.*	1·2	1·1	0·7 to 1·2	0·3 to 0·9

* *Wijs, 1 hour.*
(1) *Jamieson, "Vegetable Oils and Fats," p.* 215.
(2) *Bolton, "Oils, Fats and Fatty Foods," p.* 209.

Composition of Residual Meals

(*a*) *Undecorticated Meals.* The residual meals left after the extraction of the undecorticated seeds with light petroleum were: *Grey seed*: buff coloured; *Black seed*: purplish grey. They were examined with the following results, which are shown below in comparison with recorded results for undecorticated sunflower seed cake :

	Grey seed.		Black seed.		
	As prepared.	Calculated as containing 7·0 per cent. of fat.	As prepared.	Calculated as containing 7·0 per cent. of fat.	Undecorticated Sunflower Seed Cake*
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Moisture .	9·7	9·0	10·1	9·4	7·10
Crude proteins	22·4	20·9	21·4	20·0	19·01
Fat . .	0·3	7·0	0·3	7·0	7·43
Starch, etc. (by difference)	24·5	22·9	28·3	26·4	28·93
Crude fibre .	39·2	36·6	35·9	33·5	30·03
Ash . . .	3·9	3·6	4·0	3·7	7·50
Nutrient ratio	1 : 1·1	1 : 1·9	1 : 1·4	1 : 2·1	1 : 2·4
Food units	81	93	83	94	95

* Smetham and Dodd : "*The Valuation of Feeding Stuffs,*" 1928, p. 37.

(*b*) *Decorticated Meals.*—The residual meals left after the extraction of the decorticated seeds with light petroleum were: *Grey seed*: pale cream coloured; *Black seed*: pale cream coloured. On examination they gave the following results, which are shown below in comparison with those recorded for decorticated sunflower seed cake and meal.

	Grey seed.		Black seed.		Decorticated Sunflower Seed	
	As prepared.	Calculated as containing 7·0 per cent. of fat.	As prepared.	Calculated as containing 7·0 per cent. of fat.	Cake*	Meal.*
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Moisture .	9·3	8·7	9·3	8·7	9·15	7·50
Crude proteins	58·9	54·8	55·0	51·2	46·29	53·78
Fat . .	nil	7·0	nil	7·0	9·30	1·97
Starch, etc. (by difference) .	19·3	17·9	22·6	20·9	20·41	22·54
Crude fibre .	4·5	4·2	5·5	5·1	7·47	5·53
Ash . .	8·0	7·4	7·6	7·1	7·38	8·68
Nutrient ratio	1 : 0·3	1 : 0·6	1 : 0·4	1 : 0·7	1 : 0·9	1 : 0·5
Food units .	167	172	160	166	159	162

* *Smetham and Dodd, loc. cit.*

Composition of Original Seed

By calculation from the results obtained for the oil and moisture contents of the original seed and for the residual undecorticated meals, the original seeds had the following composition:

	Grey seed.	Black seed.
	Per cent.	*Per cent.*
Moisture	8·5	8·6
Crude proteins	17·2	16·1
Fat	22·5	24·2
Starch, etc. (by difference) . .	18·7	21·2
Crude fibre	30·1	26·9
Ash	3·0	3·0
Nutrient ratio	1 : 4·0	1 : 4·8
Food units	118	122

The results of the examination show that both samples of sunflower seed contain normal amounts of oil, the usual range being from 22 to 25 per cent. for undecorticated seed and from 40 to 52 per cent. for decorticated seed.

The constants of the extracted oils are normal with the exception of the iodine value of the oil from the grey seed, in which case the figure is lower than usual. With some oils previously examined at the Imperial Institute low iodine values have been found, while Bolton (*loc. cit.*) quotes a figure of 106 for the oil from a white sunflower seed.

The composition of the residual meals is normal.

Conclusions

In normal times sunflower seed is not imported into the United Kingdom as an oilseed from which to prepare oil, the crushing of this seed hitherto being confined to the Continent. Small quantities of sunflower seed (100 to 200 tons annually) are however sold in the United Kingdom as bird-seed, for which purpose plump seed is required.

Sunflower seed oil is little used in ordinary times in this country, but on the Continent it is employed very largely as a salad oil and in the manufacture of margarine.

As regards the crushing of sunflower seed, the pressing of undecorticated seed is not to be recommended for the reason that undecorticated seed usually contains about 50 per cent. of husk, the presence of which in the residual oil-cake results in the latter having a very high content of indigestible crude fibre (over 30 per cent.). This large proportion of "roughage" renders the undecorticated oil-cake unsuitable for use as a feeding stuff for animals, and the cake can only be disposed of as a fertilizer. For the same reason the extraction by solvents of the undecorticated seed cannot be advocated.

The more profitable method of treating the seed is first to remove the husk, for which purpose a decorticating machine of the type used for ground nuts in the shell can be employed. The husk-free seed is then either treated in an expeller or solvent extracted. In this case the residual oil-cake or meal can be readily sold as a feeding stuff as it is very rich in proteins.

MULBERRY SILK COCOONS FROM MALTA

Silk cocoon raising trials of interest in relation to the question of silk production in Colonial territories have been carried out by the Department of Agriculture in Malta. The eggs were obtained from Cyprus, and the resulting cocoons were submitted to the Imperial Institute, through the Crown Agents for the Colonies, for a report on the quality of the silk and the market value of the cocoons.

The sample, weighing 6 oz. and consisting of 212 cocoons, entire with chrysalis, was examined with the following results.

The Cocoons

Colour.—In general, pale buff to buff-white; an occasional yellow cocoon present. Uniformity moderate only.

Average Weight.

Entire cocoon with chrysalis, 0·8 gram.

Cocoon, empty, 0·35 gram.

Dimensions. Variable but, on the whole, very good.

Length (overall, between parallel blocks)

Maximum	1·7 in.
Minimum	1·1 in.
Average	1·4 in.

Width (greatest, between parallel blocks)
Maximum 0·8 in.
Minimum 0·5 in.
Average 0·65 in.

Shape.—Good, bold, regular.

Touch.—Resistance to touch on the whole good, but many cocoons less satisfactory and easily compressed, indicating thin walls usually resulting from insufficient feeding of the worms.

Texture of surface.—Fine to moderately coarse; satisfactory.

Cleanliness.—Good.

Soundness.—Good; an occasional mould-spot detected.

Freedom from disease.—Apparently complete.

Staining.—Occasional and slight; condition satisfactory.

Doubles.—None present.

Dead cocoons.—None present.

Pierced cocoons.—None present.

Attack by weevil or fly.—No evidence of attack.

The Filament

Diameter:
Bave, 0·0008 to 0·0021 in. Average 0·0013 in.
Brins, 0·00025 to 0·00075 in. Average 0·00057 in.

The maximum figures observed for the diameters of the brin and the bave are high, but local widening of the filament was observed, and this feature accounts for the high maximum figures recorded; nevertheless the average diameters of the brin and bave are of the same general order as in other samples of mulberry silk examined at the Imperial Institute.

Conclusions

Judging from appearance, measurements and hand tests, the sample comprised good, promising cocoons. Circumstances prevented carrying out the critical test for yield of silk (rendement) since no reeling machinery is available at the Imperial Institute; the general characters of the cocoons, however, suggested that the rendement would be satisfactory though the occurrence of many thin-walled cocoons, if general, would tend to reduce the figure obtained.

The absence of diseased, insect attacked and dead cocoons indicated good sericultural methods, while conditions as regards pierced cocoons, staining and doubles suggested efficient supervision.

As the cocoons were derived from seed obtained from Cyprus, in examining the sample comparison was made with cocoons raised in Cyprus available at the Imperial Institute. In general, the Malta cocoons were on the average larger and bolder but less regular in size and much less uniform in colour. They were also less firm and somewhat coarser in surface texture than the Cyprus cocoons which were a sample of high-quality white cocoons.

NOTE

The Development of the Soya Bean Crop in the United States.—The cultivation of the soya bean as an oilseed crop in the United States has developed remarkably in recent years. In addition a quite appreciable acreage is grown for fodder. In 1943 nearly eleven million acres were harvested for seed, and yielded a crop of some 196 million bushels (approaching 5¼ million long tons). This may be compared with an average of just under three million acres for the years 1932-41, and represents approximately half the acreage occupied by cotton in the same year [1].

Soya bean cultivation is largely confined to the eastern half of the country. The crop is described as well adapted to the southern half of the Corn Belt and the northern half of the Cotton Belt [9]. The chief producing States are Illinois, Iowa, Indiana and Ohio. These four States were responsible for about 84 per cent. of the crop in 1943. According to Walsh [11], increased production in the Corn Belt has been conditioned by several factors, including the ability of the plant to withstand drought, its relative freedom from pest hazards, its adaptability to crop rotations, the possibility of harvesting the beans with a small combine, and its status as a cash crop. Production has also been stimulated by the necessity of finding a more profitable crop than oats, or in some cases maize. In the South soya beans, grown mainly for forage purposes it would appear, have replaced cotton to some extent. However, despite the varied and interesting uses of soya products, the main outlet for the beans is as an oilseed for human consumption, and for the cake and meal as an animal feeding stuff.

Varietal Categories.—In the United States soya bean varieties are commonly divided into four categories. These are: Seed (grain and industrial), Forage, Green Vegetable, and Dry Edible [9] This grouping may, however, be modified by amalgamating the last two categories, which on an acreage basis are less important, into a single group, i.e. Vegetable [6]. While dual purpose varieties exist, it is noteworthy that in the main the American farmer cultivates either a seed or a fodder variety, suited to his environment, according to the purpose for which the crop is planted.

Morse and Cartter [9] state that varieties for seed production are preferably the yellow-seeded types, which are used for processing for oil, oil meal and flour. Forage types are generally those with black or brown seed, and among other characteristics usually contain less oil than yellow-seeded varieties. For dry edible or green shelled beans, the most suitable varieties are those with straw-yellow or olive-yellow seed, which cook easily and have a mild or nutty flavour. By contrast the common seed varieties have a raw beany flavour, and usually do not cook easily. In this connection, the vegetable type varieties of the soya bean may in time become of increasing interest in the Colonial Empire, where there is considerable use of pulse crops for food. In some areas it may eventually be worth while to devote special attention to them.

The same authorities list particulars (oil and protein content, seed colour, etc.) of well over 100 varieties of soya beans which are recommended with reference to the different "usage" categories mentioned above. These are classified according to the length of growing season in steps of 10 or 20 days. The varieties commonly cultivated in the United States range from very early varieties with a growing season of some 100 days which are sown in the North to the very late varieties requiring about 160 days to mature which are employed in the South.

Individual Varieties.—The soya bean appears to provide an instance of a crop with which a relatively large number of varieties may be required. In China and Manchuria there are said to be some 500 varieties [5]. Markley [6] states that the unusually large number of known varieties and strains of the soya bean appears to be the result of the peculiar sensitivity of the plant to changes in soil and climate. Much selection in soya growing countries has been directed towards increasing the yield under local conditions, and more recently with a view to improving quality for industrial purposes. The same writer defines the characters included in the term quality as applied to the industrial use of soya beans as principally oil content, iodine number of the oil, phosphatide content, and protein content. In the course of a search for new and improved soya bean varieties the United States Department of Agriculture has made more than 10,000 introductions from China, Manchuria, and other countries, representing over 2,500 distinct types [9].

According to Morse [8], in the Middle Western States, where the heaviest production of seed occurs, the varieties most extensively grown are: Illini, Dunfield, Mukden, Chief, Mandell, Scioto, Mingo, and Richland. A few other varieties such as Patoka, Gibson, Mansoy, and Macoupin are grown in the southern part of the Corn Belt. The varieties commonly grown in the Southern States are Ogden, Mammoth Yellow, Tokyo, and Mamloxi. The brown and black-seeded varieties generally grown for forage purposes in the Northern States are Wilson, Wilson-Five, Peking, Ebony, and Virginia, and in the South, Otootan, Avoyelles, Laredo, and Biloxi.

The extent to which American varieties of soya bean are likely to be of value to countries in the British Empire will, it seems, be determined by climatic considerations in each instance. The northern varieties, for example, may be of little interest in tropical regions. Perhaps the most important lesson of this American soya bean development is the need for local trial and selection on a sufficient scale in each potential soya growing country, with judicious introductions where these are necessary.

Culture, Climatic and Soil Requirements, Pests and Diseases.—In their excellent bulletin, Morse and Cartter [9] discuss cultural details at some length. It appears that in the United States soya beans succeed well in a similar climate to that required for maize. In the Northern States, however, early varieties are required for seed purposes. Once the crop is established dry and excessive wet periods are withstood. The most critical time normally occurs over germination. Frost has less effect than on maize. In general the crop is adaptable both to soil and seasonal differences. The best results are obtained from fertile loams or sandy loams. Heavy clays and light sandy soils are less satisfactory. The land should generally be in a reasonably good state of fertility. Inoculation, liming, and the use of artificial manures, all serve to widen the range of soils on which success can be obtained. The incidence of pests and diseases does not appear to be serious so far, though a number occur [4, 9].

Yield.—The average yield for the country as a whole in the years 1932-41 is recorded as 16·7 bushels (1,002 lb.) per acre [1]. There is, however, considerable variation in the average return shown from State to State. Thus for this period the average yield ranged from 19·5 bushels (1,170 lb.) per acre in Illinois to as low as 5·9 bushels (354 lb.) per acre in Alabama and Georgia. The other chief producing States have returns above or approximately equal to the national average. Southern States, however, generally show average yields below, or well below, this figure.

Market Classification.—In the United States, for market purposes soya beans are at present classified as follows: Class 1, yellow; Class 2, green; Class 3, brown; Class 4, black; Class 5, mixed [6]. In each class there are five grades; each grade has a minimum weight per bushel and maximum limits for moisture content, defective beans, foreign matter, etc. The requirements for the No. 2 or contract grade include a minimum test-weight of 54 lb. per Winchester bushel, and a maximum limit of 14 per cent. moisture, 15 per cent. splits, 3 per cent. damage, 2 per cent. foreign matter other than dockage, and 3 per cent. other colours [2]. Soya beans are, however, sold by weight, prices being quoted on the basis of a nominal bushel of 60 lb.

Commercial Predominance of Yellow-seeded Beans.—According to Goss [3], during the first eleven months of the 1943 crop marketing year, more than 99 per cent. of the soya beans marketed in the United States consisted of yellow-seeded beans. In 1943, yellow seeded beans at a price of $1.80 per bushel at local delivery points, moisture content 14 per cent., commanded a premium of 20 cents per bushel over beans of classes 3 to 5.

The question of yellow-seeded versus "coloured" soya beans has been of interest in the past in some Empire countries. In one Colony at least coloured forage varieties have been reported to give superior seed yields. It seems to be clear that in the United States the coloured types generally give lower seed yields [8] and have a lower oil content than yellow-seeded types. This is doubtless the

TERMITE-PROOFING OF TIMBER FOR USE IN THE TROPICS. Department of Scientific and Industrial Research, Forest Products Research Laboratory, Leaflet No. 38, August, 1944. Pp. 6, 9½ × 6. (Forest Products Research Laboratory, Princes Risborough, Aylesbury, Bucks.)

The protection of woodwork against destruction by termites is one of the serious problems of life in the tropics generally, as well as in some warm temperate regions.

This Leaflet, which summarises information from various sources, chiefly publications of the Forest Research Institute, Dehra Dun, and the Bureau of Entomology, United States Department of Agriculture, deals with the incidence of the pest and methods of combating it.

There are about 1,700 species of termites, some of which are ground dwellers, including both subterranean and mound-building groups, and others are wood dwellers which rarely or never enter the ground. It is stated that 95 per cent of the damage caused to woodwork in buildings by termites throughout the world is done by subterranean species. Where this is the case, buildings and their contents can be protected by structural or other methods designed to prevent communication with the earth, since these insects cannot live without access to moisture in the soil. Where purely wood-dwelling species are concerned other means, such as chemical preservatives, must be employed, and a summary of the various methods of treatment is given. For timber in contact with the ground, coal tar creosote applied under pressure is the most effective, but there are objections to creosote in many cases, and for interior work a number of other treatments are mentioned. Plywood and fibre or composition boards also call for special treatments.

The question of termite-resistant timbers is also considered. No commercial timber can be regarded as entirely immune from attack, and it has been found that a particular timber may be more resistant in one country than another, but in general the heartwoods of the following are among the most resistant: Iroko (*Chlorophora excelsa*), Opepe (*Sarcocephalus diderrichii*), Pacific Coast Redwood (*Sequoia sempervirens*), Teak (*Tectona grandis*). The sapwood of all timbers is liable to attack.

A short list of other publications containing more detailed information is given at the end of the Leaflet. F. F.

CO-OPERATION IN FORESTRY. By I. Kissin, M.A., D.Phil. Imperial Forestry Bureau, Technical Communication No. 2. Pp. 72, 10 × 7½. Price 4*s*. 1944.

FORESTRY CREDIT. By I. Kissin, M.A., D.Phil. Imperial Forestry Bureau, Technical Communication No. 3. Pp. 27, 10 × 7½. Price 2*s*. 6*d*. 1945. (Imperial Agricultural Bureaux, Central Sales Branch, Penglais, Aberystwyth.)

In spite of the difficulties in collecting information due to war circumstances, and to the fact that the survey of co-operation in forestry is not as comprehensive as had been originally intended, the author has produced in the first of these technical communications what should be an extremely useful study of the material available to him. Co-operative societies are considered in two classes; societies of forest owners, whose activities may embrace all aspects of forestry, and may extend to the processing of forest produce, and societies of forest workers, who have combined for collective production, the operations of which normally commence with forest exploitation, and often extend to processing.

Considering societies of the first class, a very full account is provided of the forestry co-operative societies of Great Britain. Further chapters are devoted to the Danish societies of forest small-holders, the Finnish forest management societies, and to the farm-woodland co-operatives of the United States. Another chapter describes societies marketing timber in Scandinavian countries, the maple-syrup producing societies of the United States, and agricultural societies dealing in forest products of Canada, the United States and Japan.

Societies of the second class, those of forest workers, have developed chiefly in the Soviet Union, Roumania and Bulgaria, and form the subject of Chapter 7. In Russia forest-industrial co-operative societies, forming a part of the industrial co-operative movement, undertake a wide range of activities extending from forest exploitation, and the conversion of the produce, to timber manufactures and the chemical utilisation of wood. Reference is also made to the co-operative forest "syndicates" of Quebec, and to the recently formed "pitsawyers" society in the Gold Coast. The latter is the only forest co-operative society mentioned with respect to the Colonial Empire.

The second technical communication is published as an outline study of the subject of credit in forestry. While every attempt has been made by the author to base his discussion of the various aspects on as wide a range of literature and other evidence as possible, it is recognised that the data used have often been scanty, as was unavoidable in present conditions. The subject is considered under the following headings, which form separate chapters: functions of forestry credit; the problems of forest mortgage credit; some general trends in the provision of forestry credit; forestry credit in Germany, Norway and Denmark; forestry credit in the United States; and finally notes on forestry credit in Britain and the Dominions.

Short Portuguese and Spanish summaries are provided with both publications.

E. H. G. S.

SIERRA LEONE. GENERAL VIEW OF ALLUVIAL DIAMOND MINING.
Reproduced from a Diorama in the Exhibition Galleries of the Imperial Institute.

MINERAL RESOURCES

ARTICLE

A NOTE ON SOME LARGE DIAMONDS RECENTLY RECOVERED FROM THE GRAVELS OF THE WOYIE RIVER, SIERRA LEONE

By W. T. Gordon, M.A., D.Sc., F.R.S.E.,
Professor of Geology, University of London

The finding of three exceptionally large diamonds in Sierra Leone since March, 1943, has already been announced in this Bulletin (1943, **41**, 206 and 1945, **43**, 55). All three stones came from workings in the Woyie River gravels and were obtained in the normal course of diamond recovery at the plant operated by Sierra Leone Selection Trust, Ltd. They are by far the largest diamonds of gem quality yet found in Africa, apart from the Union; one, indeed, is probably the largest diamond ever found in any alluvial deposit. As such they are of considerable scientific interest apart from their intrinsic value.

It is a curious circumstance that all the exceptionally large diamonds found in recent years have been irregular in shape, and the three discovered in Sierra Leone during the past two years are no exceptions. All these large specimens have been single individual crystals; indeed, even if irregular in development, single individuals are common among diamonds. Crystal aggregates of diamond are, on the whole, rare, if we exclude the two important industrial varieties *carbonado* and *ballas*, the former a compact mass of small crystals and the latter with a fibrous radiating structure.

Diamonds from Sierra Leone are interesting from several points of view and notably because of the frequent occurrence, in material of good quality, of octahedra with extremely flat faces and clean-cut edges. In the lower qualities, crystals, though well formed, often have rough faces and sometimes a skin that consists of extraneous substance embedded in a diamond meshwork, each part of which is in crystallographic continuity with a central core of good quality. The skin may be thick or thin, and not infrequently appears to have the extraneous material arranged in a very regular pattern.

As with diamonds from other localities, the crystal faces are pitted. Octahedral faces have triangular or, rarely, hexagonal pits, and the triangles are equilateral in shape (Plate IV, Fig. 5). Cube faces have square pits, with their edges diagonal to the cube edges.

The octahedral faces of Sierra Leone diamonds are sometimes so smooth that pits are quite minute and difficult to detect. The writer has never seen one absolutely devoid of pits, though sometimes it required examination under quite a high-power microscope objective to be certain that such pits did occur.

But the three large stones that are the basis of the present short account are not in this category. Indeed the largest, and latest to be found, has one octahedral face with triangular pits that are larger and deeper than any previously recorded (Plate IV, Fig. 5). Some of them measure nearly 6 mm. on edge and are about 1 mm. deep. They are arranged in parallel position, as usual, and set with their sides towards the points of the ideal octahedron. The spacing of the pits is such that the areas between them assume raised, shield-shaped, triangular forms; the points of the shields and those of the pits are in ranks facing opposite directions.

The largest specimen (No. 1), found in the Woyie River gravels in January, 1945, is 770·00 carats in weight, *i.e.* 154 gm., or nearly 5½ oz. It is rather lozenge-shaped, some 71 mm. long, 53 mm. broad, and 32 mm. thick (Plate IV, Fig. 4). These measurements are approximate as they depend on the direction in which they are made. Roughly speaking, the crystal is like a four-sided, truncated pyramid on a lozenge-shaped base, as can be seen in Figures 4 and 6.

The boundaries are mostly natural, but only one is what one might call a free crystal face, the other surfaces being either irregular or the result of cleavage. The one natural octahedral face is some 55 mm. by 25 mm. in area, and, taken in conjunction with two cleavages (one a remarkably perfect cleavage surface measuring 40 mm. by 28 mm.), serves to determine the orientation of the crystal. When placed in such a position that the cleavage directions (as indicated by fractures or the pitted face) would be parallel to the faces of an octahedron, the amount of distortion of the specimen from an ideal octahedron can be seen, and the direction of some of the main edges can be ascertained. Thus, in text Fig. 1 the edge A-B, indicated by the same letters in Plate IV, Fig. 5, is parallel to the diagonal of the cube to which the specimen could be related from a crystallographic point of view; and the degree of irregularity of the individual can be seen. Although some surfaces can be properly ascertained, the remainder of the external surface facets on the specimen cannot be accurately determined. They all show striations and a kind of general corrosion, while the main edges and corners are distinctly battered as by water erosion. Characteristic chatter cracks are visible in Plate IV, Fig. 5, on the edge A-B towards B, for light is reflected from these cracks and gives white, spindle-shaped marks in the dark shadow.

Such mechanical erosion may have occurred at any time since the crystal was dislodged from the parental rock, and may have happened close to the place where it was found. If there had been pot-holes in the bed of the Woyie stream above the point of location, the chattered edges might be explained, and the original source might not be far distant; but diamond is so hard that the specimen might have travelled a considerable distance, or might have been washed out of some more ancient gravel bed before incorporation in the present gravel.

On the other hand the presence of not one, but three, large stones in fairly close proximity to one another, favours the presumption of a local source. Careful physiographic surveying of the area upstream, and detailed geological mapping of the rocks and superficial gravel beds in the vicinity may indicate whether this presumption is correct.

Reverting to the largest specimen, however, it can be stated definitely that it has not suffered much attrition since the largest cleavage face was produced, for the smaller edges peripheral to that face show no sign of battering. The area of this cleavage face is 11·5 sq. cm., and it is so clean a fracture that the blow which produced it must have been a sudden, sharp impact in precisely the correct direction. The surface is exceedingly smooth, whereas most cleavage faces show a certain stepping from layer to layer while keeping in the same general direction. The blow need not have been a heavy one, but the marvel of the smoothness of the fracture-face can only be appreciated by those who have tried to cleave a diamond, using the usual cleavers' tools.

Certain of the other facets suggest that the history of the stone is not so simple. There are sometimes slightly conchoidal ridges, indicating fractures that took place at an earlier time, and that have been corroded during the period that elapsed between that event and the production of the latest cleavage surfaces (Plate IV, Fig. 4). These conchoidal fractures might have been produced while the diamond was in its original rock and subjected to earth strains. A possible history might be hazarded. There seems to be common consent to the idea that diamond is formed in molten rock material, and that the diamond crystallises out at an early stage as the magma (rock liquid) cools. Thus is explained the observation that diamonds are usually individual crystals, and their faces more or less alike as regards size and depth of pits. Elongated or flattened crystals are common, it is true, and indeed, a mathematically exact octahedron is very rare. On further cooling of the magma, other minerals will crystallise out of the rock melt on the faces of the diamond, and the resulting group of contiguous crystals would form a mass that might migrate from place to place as a result of currents in the semi-congealed rock. In consequence, the mass may reach a part of the magma where the conditions of crystallisation were reversed, and re-solution supervened. The crystals round most of the diamond might melt again, and even the diamond itself might be attacked by the liquid, which would, of course, be somewhat similar to that from which it had originally crystallised; or the attack might be by gaseous magmatic constituents like oxygen. The mantle of the other crystals might not melt completely, however, in which case parts of the diamond would be protected from all these chemical changes. Explosions, too, might occur in the magma, because of sudden evolutions of gas, and these might result in a brecciation of the solid contents, among them the diamond itself.

In the light of these ideas, examination of the large specimen can be pursued from another angle. The pitted face might have had other minerals crystallised on it, and might, therefore, have been protected from re-solution by the magma, whereas the rest of the specimen was subjected to corrosion and to impacts that caused the conchoidal ridges and grooves. The general corrosion would occur on all surfaces that had been produced and exposed up to that time. Complete disentanglement from the parent rock, after the latter had weathered and had been subjected to mechanical disintegration, would permit the diamond to be washed into a stream, with other stones, and to be battered, may be, in some pot-hole or whirlpool. The chatter cracks would be most apparent on the edges and corners, as is the case. Finally, perhaps after an interval, the last cleavage would have some edges that were not battered. Such a story would fit in reasonably with the characters of the specimen.

There are some other interesting speculations: How large was

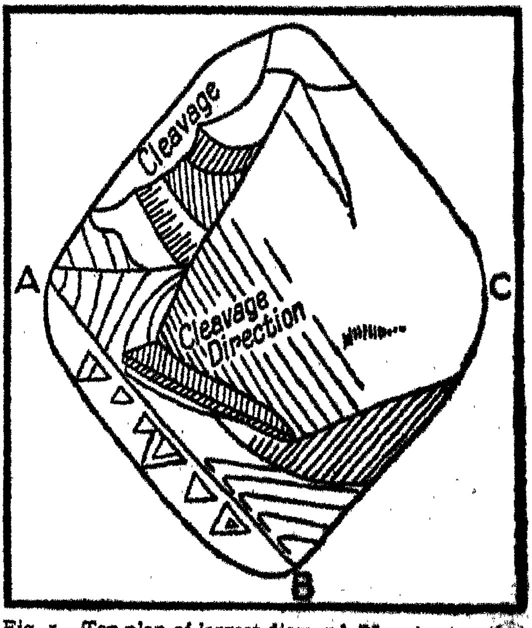

Fig. 1. Top plan of largest diamond (No. 1) set so that cleavage directions are across the corners of the cube, *i.e.*, parallel to the octahedral faces.

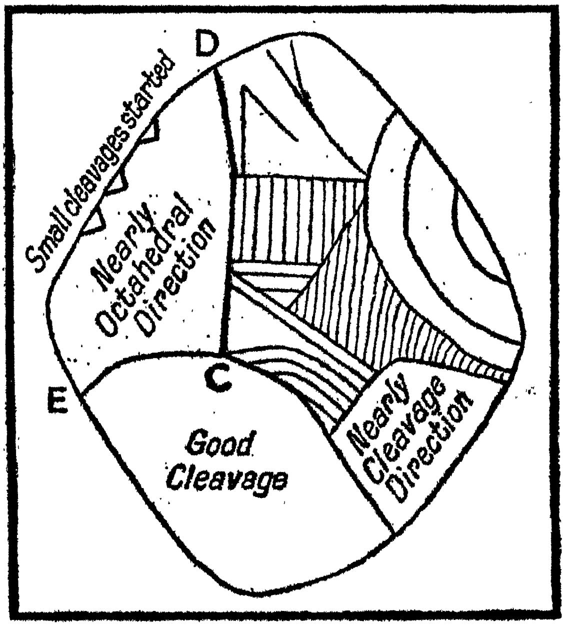

Fig. 2. Basal plan of largest diamond (No. 1) set as in Fig. 1.

the original stone, for example ? The only natural face is the one with the triangular pits and its longest edge is about 55 mm. A perfect octahedron with this length of edge would have weighed around 1,400 carats. If, however, we place the specimen so that the one natural face and the cleavage planes are set in their proper orientation with respect to a cube, as has been done in text Fig. 1, it is significant that the edge A-B is parallel to the diagonal of the cube, which seems to suggest that the original octahedron was elongated in growth, the edge A-B taking the place of an octahedron point. In that case no simple calculation for the original size is possible, and the crystal may have weighed even more than has been suggested. Turning the crystal over, and again setting it by the cleavages, it appears like text Fig. 2, and the prominent edges C-D and C-E are almost in the direction of octahedral edges, *i.e.* in planes perpendicular to cube edges. It is true that the edges are rather curved, but corrosion might have attacked the crystal so that the original direction of prominent edges was irregularly preserved.

There is no special significance about these speculations, except to suggest that the original crystal was irregular in shape, one side being more nearly pyramidal than the other, the latter having an elongated edge replacing the apex in the former. Hence the edges in the second would be parallel to the cube diagonal ; in the first to the cube edge. These speculations are probably rather futile, but the net result suggests that the stone was once larger, though there is no sign that it is merely the smaller piece of a *much* larger specimen.

The second diamond (No. 2), which was found in June, 1943, weighs 532·00 carats, *i.e.* 106·4 gm. or about 3¾ oz. It has one flat side, which is parallel to the cleavage direction, and the remainder of the stone rises to a crest, as shown in Plate IV, Fig. 1. The front and back surfaces are domed and covered with somewhat irregular facets that show corrosion striations. The shape is not unlike that of the Jonkers diamond from South Africa. The large flat side is practically along the cleavage direction, and this fact might be taken to suggest that the stone was part of a rather larger specimen.

With the exception of the more recent cleavage facets, the surfaces are all corroded, and, if the flat is regarded as the separation-surface of the two parts of an original crystal, then the break must have occurred at a very early stage in the history of the specimen, because that flat is grooved and corroded. The prominent edges and corners, again, have been battered by mechanical attrition.

Setting the specimen in crystallographic relation to a cube, as in text Fig. 3, amounts to turning the photograph (Plate IV, Fig. 1) nearly through 45°, and it is interesting to note that in this stone also an edge is parallel to the cube edge. This might imply that the large surfaces on this side of the stone were faces of a six-faced octahedron form. The reverse face (text Fig. 4) again has an edge parallel to the cube diagonal, and the surfaces are very nearly octahedral planes. Three of them, being cleavage surfaces, actually *are* octahedral planes. The fourth is more irregular but is still

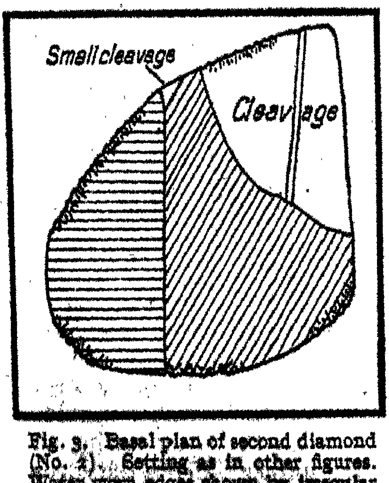

Fig. 3. Basal plan of second diamond (No. 2). Setting as in other figures. Water worn edges shown by irregular shading.

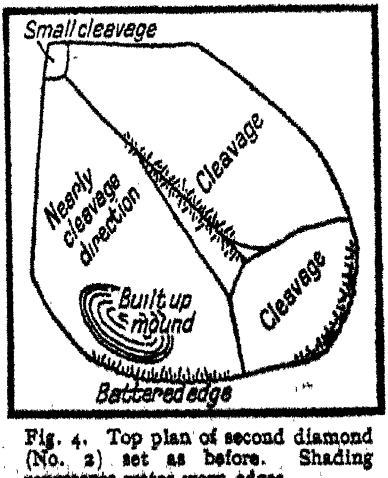

Fig. 4. Top plan of second diamond (No. 2) set as before. Shading represents water worn edges.

almost parallel to an octahedral face. When viewed in this position the edges are all more or less battered by mechanical erosion.

The smallest of the important diamonds (No. 3), found in March, 1943, weighs 249·25 carats, *i.e.* 49·85 gm. or about 1¾ oz. As a crystal it is more interesting than the other two, though as a diamond it is not as spectacular. The dimensions are 53 mm. long by 21 mm. broad at one end and 36 mm. at the other. The thickness is 13 mm. When placed in proper crystallographic position (text Fig. 5) it is seen that the long rectangular face is a cube face, and this is confirmed by the pits that are four-sided, with these sides set diagonal to the cube edge. Pits of this type are characteristic of cube faces on the diamond. The sides of the pits are at such an angle that they are really small, negative, octahedral faces, and some of them have the characteristic triangular pits of the octahedral faces themselves. In other words, the bounding surfaces of the pits are reverse octahedral faces and are themselves pitted, as might be expected, like octahedral faces.

There is, however, another interesting feature shown on this cube face. Relatively smooth areas have curious, minute, shallow, square-shaped hollows set in series so that their curved surfaces meet in edges that are parallel to the diagonals of the cube. The general appearance of these dimple-like depressions (text Fig. 6) suggests that they are real etch hollows, *i.e.* that they are due to chemical action removing the substance of the diamond. The

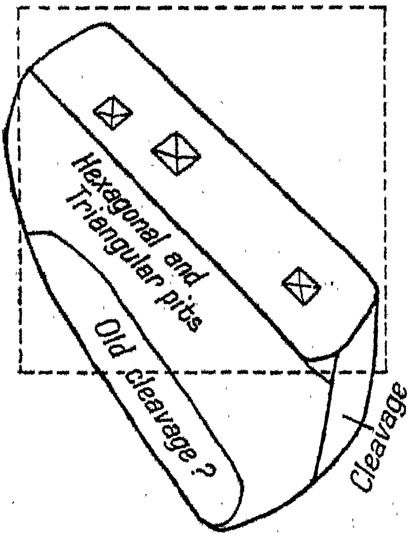

Fig. 5. Sketch of smallest diamond (No. 3) showing cube face on top and octahedral face on side. Dotted square represents top face of the cube to which the crystal has been related.

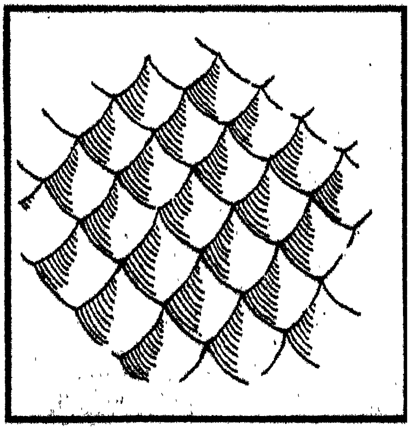

Fig. 6. Diamond No. 3. Minute hollows in regular sequence on cube face, edges diagonal to cube edges. These are regarded as ablation pits.

author has seen very similar hollows, though on a much grander scale, on the surface of a *névé*-field that was disappearing by ablation, in Novaya Zemlya, during the summer of 1937. In that case the hollows had hexagonal boundaries, as would be expected, since ice is hexagonal in crystal structure. On the vertical edges of this *névé*-field a series of vertical flutings were associated with the hexagonal hollows on the top surface. In other words there was a prismatic crystal structure in the mass that was evidently being brought out during the melting of the whole by ablation.

Now, on the cube face of the diamond, one would expect square outlines associated with any similar ablation hollows, and the occurrence of precisely that kind of curved hollow drives one to the conclusion that the phenomenon is probably due to some kind of chemical attack on the diamond. Oxidation to carbon dioxide and consequent disappearance as gas is the most obvious explanation.

When the long narrow surface is set parallel to the diagonal of a cube face (text Fig. 5) the relationships of the several natural crystal planes become apparent. The front face, sloping towards the lower corner of the cube, is an octahedron, as is also the back parallel face. The cleavage surface on the lower end comes into its proper position on the adjacent corner of the cube. What appears to be an old cleavage surface also fits in appropriately.

The large flat octahedron faces (the largest surfaces on this specimen) are equally interesting. One is shown in Plate IV, Fig. 3, and is covered with pits of two kinds, triangular and hexagonal. The latter have been recorded on diamond previously, but rarely are so abundant as in this specimen. The edges of both types of pit are, of course, parallel (Plate IV, Fig. 7).

On the opposite side to the cube face there is a surface (marked "old cleavage" in the text figure) that has some interest. The surface is parallel to the cleavage. It has minute striations and a low ripple such as might occur on a cleavage surface; but there is also a glazed appearance that suggests some kind of corrosion after the break had taken place. A more recent cleavage is also shown and a conchoidal fracture of about the same date, but there is less evidence of battering on this specimen than on the other two.

Thus, all three stones seem to show a parallel history. In an intertelluric stage they seem to have suffered both mechanical attrition and chemical attack. The former produced fractures and the latter a kind of corrosion of the whole exterior, perhaps by gaseous attack; yet the ablation was so uniform that the direction of original edges seems to have been preserved and some faces have had the pitting preserved, possibly by protection afforded by other minerals that had crystallised on these faces, and had remained after the other parts of the diamond had been re-exposed to the action of the magma. Of course it is known that ablation of the diamond, when heated in air, produces similar triangular pits to those that have been taken above as produced in the original crystallisation. But the wonderful pitted face of the largest specimen, and those on the smallest, seem to be best explained in relation to the other surfaces if they are presumed to represent an earlier part of the history of the stones.

After release from the original parent rock by natural processes of decay, all three specimens have been subject to mechanical attrition. In the two larger the edges have suffered considerable battering, though it did not necessarily require a prolonged time to effect that erosion. The smallest did not suffer so much, but it also has recent cleavage fractures.

The quality of the material of these diamonds is high ; inclusions are present, and some cleavages have been started that do not go right through the stones, but, none the less, very beautiful gems will be cut from them.

The large size of all three of these diamonds militated against determining whether they were of the type I or type II variety of Robertson, Fox and Martin. (*Phil. Trans. Roy. Soc., Ser. A.*, 1934, **232**, 463-535.) But it is hoped that fragments of each may be made available, when the individual stones are being fabricated, so that this character may be ascertained.

It will be interesting to see whether further geological surveying of the neighbourhood proves the presence of diamond-bearing Kimberlite similar to occurrences in South Africa. A study of the minerals associated with the diamonds in the gravel might also be useful in determining provenance.

In conclusion, I would thank Mr. F. Hickenbottom for redrawing the text figures, Mr. E. H. Cooper for preparing the prints used in Plate IV, and the Diamond Development Co., Ltd., and the Sierra Leone Selection Trust, Ltd., for permission to use the negatives of photographs of the diamonds.

PLATE IV

(opposite)

Photographs, natural size unless otherwise stated, of the three large diamonds described in the text. These are from untouched negatives in the possession of the Diamond Development Co., Ltd. and the Sierra Leone Selection Trust, Ltd.

Fig. 1. Diamond No. 2 (532·00 carats). General view. The straight vertical edge on the left is really parallel to an octahedron face.

Fig. 2. Diamond No. 3 (249·25 carats). Top view of the smallest diamond. This shows the deeply pitted cube face with squarish pits; the bottom edge is determined by a cleavage face.

Fig. 3. The same diamond as fig. 2, showing one of the flat octahedral faces. The pits are either triangular or hexagonal in shape. *See also* fig. 7.

Fig. 4. Diamond No. 1 (770·00 carats). The largest diamond set to show the general lozenge shape.

Fig. 5. The same as fig. 4, illustrating the large triangular pits and raised shields on the octahedral face. The edge AB shows percussion cracks well developed about two-thirds of the way from A to B.

Fig. 6. The same diamond, the side opposite to that shown in fig. 4.

Fig. 7. Top left-hand corner of fig. 3, magnified 3·5 diameters to show the triangular and hexagonal pits.

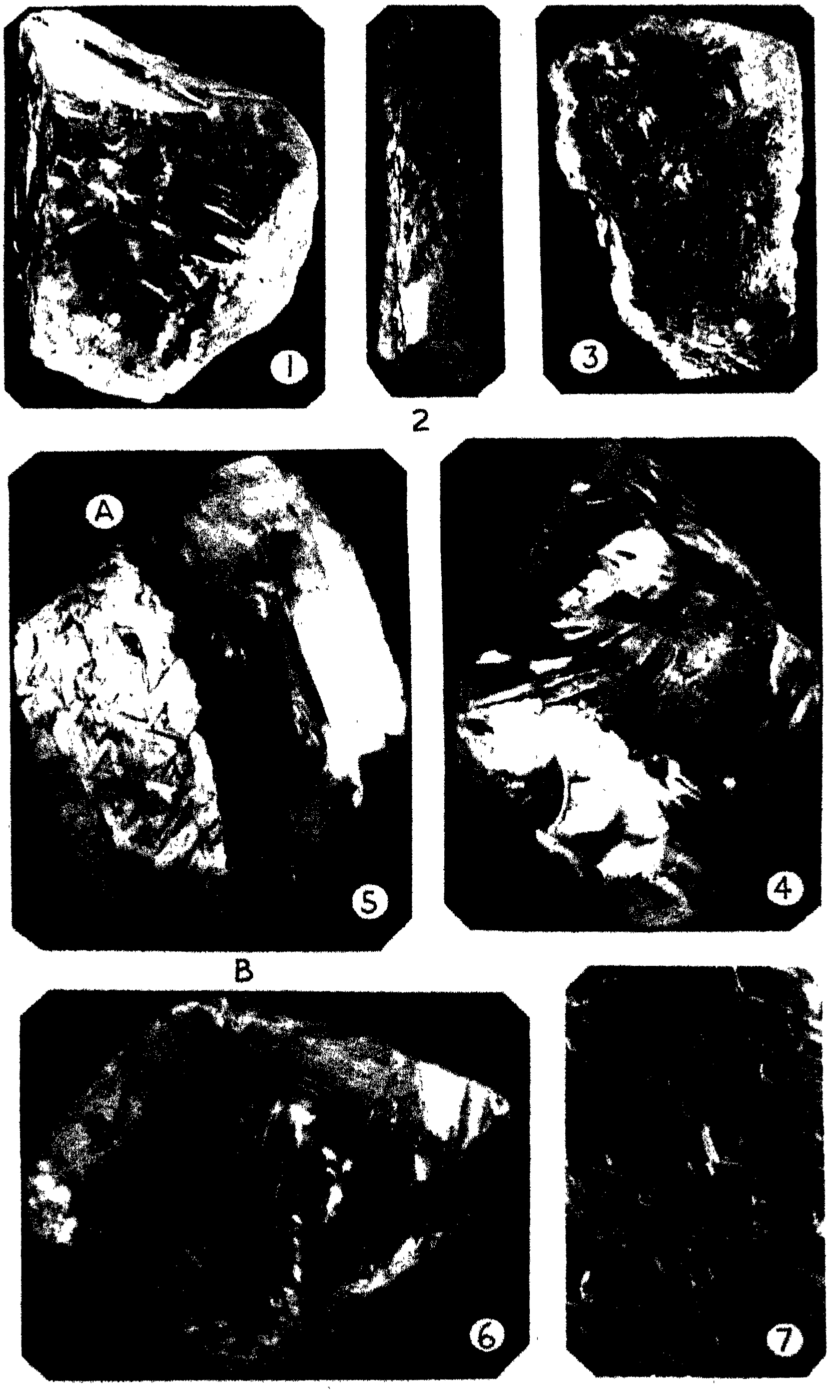

PLATE IV.—Large Diamonds from Sierra Leone.

ABSTRACTS AND NOTES

Geological work in Tanganyika.—In continuation of the reports on the progress of the work of the Geological Division of the Department of Lands and Mines, Tanganyika, published in this BULLETIN last year (1944, **42**, 49-52), the following account of work carried out by the Division during the year 1944 has been received from the Chief Geologist.

Field Geology.—Three geologists were occupied on economic mineral reconnaissance in three widely separated areas of the Territory. The first of these was the general area adjacent to Njombe in the Southern Highlands Province, where extensive deposits of titaniferous iron ore were surveyed, one (much the largest) being at Liganga in Eastern Upangwa, and the other group about nine miles south of Tandala mission. These deposits aggregate well over 1,200,000,000 tons of magnetite containing about 12 per cent. of titania, and although within 40 miles of the large coal deposits of the Ruhuhu basin their remote situation and refractory nature render them for the time being unexploitable. The presence of chromite was observed in North Ukinga in association with serpentine, and traces of gold were detected near Igawa, not far from the Great North Road, where it is associated with a granodioritic cupola penetrating basement gneiss.

The second field party operated in the North Ufipa and South Kigoma area, which was selected for survey on account of its proximity to lake and rail communications and to the valuable base metal (lead-copper) prospect of Uruwira Goldfields, Ltd., at Mpanda. A large deposit of manganiferous magnetite displaying affinities with the gondites of Southern India was discovered near Namanyere, but the most important part of the work, which is still in progress, is in connection with the Namwele coalfield. Shafts are being sunk in the known coal measures, and exhaustive tests, including locomotive trials, are being made on coal obtained from depth. At the same time a diamond-drilling programme is being planned to try to locate buried coal measures farther to the north-east in the Rukwa trough, where the coal would be more favourably situated for use for lead smelting at Mpanda and for fuel on the Central Railway.

The third party operated along rail and main road communications in the north-eastern part of the Territory, attention being devoted to the examination of such useful non-metallic minerals as might be expected to occur in the Lower Basement Complex. Small deposits of asbestos, vermiculite, limestone, garnet and kyanite were located and examined, though none of them proved particularly promising even for local use. The most interesting find recorded was a small pocket of eluvial quartz crystals of piezoelectric grade derived from a disintegrated pegmatite. The largest crystal weighed 5 lb. and was valued in London at about £10, while the average value of the 50 lb. or so of usable material is anticipated to be in the neighbourhood of Sh. 20/- per lb. It is clear that many such deposits of this high-priced strategic mineral may be expected to occur in the Lower Basement Complex, though it will be next to impossible to locate them on a useful scale without local native co-operation.

Before the commencement of the 1944 field season proper, some work was carried out on the corundum deposit at Matumbulu, near Dodoma, to gather supplies of raw material for the Abrasives Factory (see below). An eluvial pocket was located which yielded nearly four short tons of practically pure corundum at a supervised-labour cost of just under seven cents per lb. (100 cents equal one shilling). Later, unsupervised labour was used, the necessary tools being issued on loan by the Geological Division. This arrangement worked very well, and several more tons of corundum, comprising both eluvial material as well as that clean-cobbed out of the rock, were brought in by Gogo tribesmen, who were paid 8 cents per lb. for it.

At Mleha Hill, near Itiso in N.E. Dodoma District, another small corundum deposit was also opened up, and some 13 tons of massive whitish corundum with sapphirine blue zoning were obtained.

Concurrently with the mineral survey, reconnaissance geological survey was carried out, an aggregate of about 10,000 sq. miles of country being mapped on a scale of 1 : 300,000.

Laboratory Section.—There was a still further decline in the gold-mining industry, Geita, New Saza and Buhemba being the only three large mines still producing. With smallworker activity largely disrupted owing to the war, the demand for fire assays of gold ores, once such an important part of the laboratory's functions, continues to diminish. Only thirty fire assays for precious metals were performed, of which twenty-seven were for the general public. No laboratory investigations of gold ores were made, nor was it necessary for the government metallurgist to carry out his customary inspections of the various goldfields.

The ore-dressing laboratory was used for work on talc, corundum, columbite and iron ores. Some studies of fuel were undertaken upon samples from the Namwele field and elsewhere. Considerable attention was devoted to building materials, including Portland cement, Sorel (magnesium oxychloride) cement, magnesia, lime, pozzuolanas, clays, bricks and tiles. Experiments on the manufacture of Sorel cement roofing tiles were not promising, but a method for stabilizing mud-bricks by addition of lime was worked out and proved by test to be efficacious. Ceramic materials received much attention, including, in addition to clays, talc, soapstone and Kisii (Kenya) stone (a form of agalmatolite). Many investigations on the production of commercial abrasive articles from corundum and a number of tests on mineral pigments were made. A good deal of miscellaneous work was performed for other government departments, as well as in the search for local substitutes for imported articles. A number of items of large-scale laboratory plant were designed and constructed locally for the purpose of emergency production of commercial articles from local raw materials.

Abrasives Factory.—The Abrasives Factory, set up at Dodoma primarily for the manufacture of 80,000 corundum slipstones for sharpening rubber-tapping knives, functioned satisfactorily throughout the year. The above-mentioned quota was completed well in advance of schedule, and, in addition, nearly 4,000 abrasive articles of other types were made for various local industrial uses and for export to neighbouring territories. Three-quarters of a ton of specially graded corundum grit was supplied for the dehusking of rice, and small quantities of other graded grits were sold. Corundum "flour" for use with a locally designed and manufactured hone was marketed for sharpening razor-blades.

Publications.—The only printed publication issued by the Geological Division during the year was a comprehensive one dealing with the mineral resources of the Territory (Bulletin 16), and it is intended that this shall be kept up to date and revised editions issued periodically. As a wartime measure a new series of Mineral Resources Pamphlets (typescript, illustrated by sunprints) was initiated in 1943, and twenty-one have so far been prepared.

Corundum and Mica Production in Nyasaland.—Between the Wars there was virtually no mineral production in Nyasaland, and it is therefore gratifying to report that since 1943 two minerals, corundum and mica, have been mined and exported from the Protectorate.

The corundum deposits now being worked are situated on the lower slopes and around the base of Tambani Mountain, a prominent feature on the Portuguese border W.N.W. of Blantyre. The mineral was discovered in this area by T. E. G. Bailey, of the Imperial Institute Mineral Survey, during his first visit to Nyasaland in 1906. For many years the occurrence was neglected, partly in the mistaken belief that it lay in Portuguese territory, but since 1929 the Nyasaland Geological Survey has examined the deposits on several occasions and called attention to their potentialities. The corundum is now being worked by the Gifter Corundum Company, of Pietersburg, Transvaal, the principal producer of that mineral in the Union of South Africa.

The Annual Report of the Nyasaland Geological Survey for 1943 contains the latest description of the Tambani deposits. Corundum appears to occur over an area of about 90 sq. miles around the Tambani and Ntondwe mountains which consist of gneiss with a core of biotite- and nepheline-syenite. Its primary mode of occurrence is as a constituent of dykes and veins of plumasite (plagioclase-corundum pegmatite) which intrude the gneisses of the Basement Complex. The pegmatite dykes are lenticular in form, and occur at intervals over a fairly wide area, but are rarely more than 100 or 200 ft. long or more than 4 or 5 ft. thick at the centre. These have given rise to numerous patches of eluvial corundum, and as yet it is the latter alone which have been worked. The eluvial material merely requires digging, sieving and washing to yield a product of quite high grade and good market value. Rough estimates of some of the eluvial patches suggested that the ground yielded from 2·6 to 9 per cent. by volume of corundum. In the Transvaal it proved possible, in pre-war days, to mine eluvial deposits containing as little as 5 per cent. by volume of corundum, although those worked generally yielded between 10 and 20 per cent. of corundum. Recently the price of corundum has been about £19 10s. per short ton, as compared with £8 before the war. Zircon, in well formed crystals, is found in association with the corundum, but the amount recovered has so far proved to be too small to be worth the trouble of separate collection, and it is discarded. Under war conditions it has been essential to maintain the highest possible rate of production, and so the pegmatite dykes have been left untouched, but under normal conditions it would be desirable to work the dykes and eluvial ore together.

The resumption of mica production in Nyasaland recalls the spate of activity which followed the discovery of commercial mica there in 1909. In the three years 1910-1912 more than 100 tons of mica, valued at £11,444, were collected from numerous scattered surface deposits, mainly in the Dedza district, and exported to Britain, but no proper mines were established, and a few years later all activity had ceased.

During 1943 production was on a small scale, the exports being termed " samples." Mica was won in a number of places in the Northern Province extending from Mzimba Boma along the Kasitu Valley to Ekwendeni. The best quality mica, of brown-to-ruby type, was obtained from Kanye Waye, by Mt. Masosa. This deposit was followed down to 25 ft. without any signs of deterioration of quality or size. Generally speaking, the mica from the Kasitu Valley is a slightly green type with a tendency to be of the " red spotted " class, and is second grade. Even so it is said to realize an average price of 8*s.* per lb. In the immediate vicinity of Mzimba Boma the mica is free from red spots and stains. Samples of mica were also received from the Ncheu District and were sufficiently promising to justify further prospecting.

T. D.

Coal, Bauxite and Cement in Nyasaland.—The annual report of the Nyasaland Geological Survey for 1943 contains some interesting information on three materials, coal, bauxite and cement, the future development of which in Nyasaland may be closely interdependent. The exploitation of the Mlanje bauxite deposits which is now under consideration would require coal, and it has therefore been necessary to investigate the Nkombedzi (or Sumbu) coalfield to determine whether it would meet these requirements. The possibility of establishing a small cement factory using the clay deposits of Lake Malombe is also dependent on fuel supplies, which could only be met economically if Nyasaland coal became available.

Coal.—The Nkombedzi coalfield was examined by the geologist, H. E. F. Savage, who had been seconded to the Anglo-American Corporation of South Africa, Ltd., for that purpose. Eight months were spent in the field between February 1941 and June 1942. Earlier investigations in this district, where coal was first reported in 1897, have been described by Dr. F. Dixey in the *Mining Magazine* 1926, 34, 148-157. The coalfield covers an area of about 80 sq. miles at the headwaters of the Nkombedzi-wa-fodia River, extending along the telegraph line from Blantyre to Tete as far as the Anglo-Portuguese boundary. Geologically the area consists of Karroo rocks which here comprise two series of massive sandstones and grits between which occurs the coal-bearing shale group.

By far the commonest type of coal bed seen consists of interlaminated coal and shale in which the individual layers vary from microscopic dimensions up to about half an inch in thickness, this type being described as " Rich Coal-Shale." It grades upwards into " shaly coal " (coal predominant) and downwards into " coal-shale " (shale predominant). Beds of each type may reach thicknesses of as much as 20 ft. or even more, but usually the thicker beds consist of bands of all three types or are split by several feet of barren shale. There are numerous beds of homogeneous coal, two main types being distinguishable : a bright coal, light in weight, soft and friable when weathered, and a dull, hard and heavy coal. Normally the homogeneous seams range in thickness from 6 in. to 10 ft., but composite seams up to 20 ft. thick, have been observed. All the different types of coal beds have in places been anthracitised to varying degrees by adjacent dolerite dykes and sills.

In the shale groups eleven distinct coal horizons can be identified, although all are not continuous throughout the whole length of the field. Some of the seams appear to pinch out and others are interrupted by local faults. In one area there is a continuous succession of coal horizons, and of the 2,850 ft. of shales and grits here developed approximately 570 ft. are made up of coal or coal-shale. There is an estimated total length of 49½ miles of coal-bearing seams ; homogeneous coal is known to occur over the whole length of them, and eight coal seams are worthy of consideration as economic assets. Some of the coal will have been spoiled by the doleritic intrusions, but that is a disadvantage encountered in many of the coal mines of Southern Africa.

Analyses of Nkombedzi coals are shown in the following table, together with those of the principal coals of Southern Africa for comparison.

Analyses of Nkombedzi and other African coals.

		1.	2.	3.	4.	5.	6.	7
Moisture .	*per cent.*	4·79	1·05	1·39	- -	0·71	0·53	2·22
Volatiles .	,,	24·80	22·40	24·88	22	21·51	15·17	25·83
Fixed Carbon .	,,	51·44	48·54	45·58	60	64·11	71·57	57·19
Ash . .	,,	18·97	28·01	28·15	13·2	11·05	11·41	14·76
Sulphur . .	,,	0·59	0·59	0·56	—	2·62	1·30	0·53
Evaporative Power .		*10·57*	*10·45*	*9·96*	12·86	13·00	-	12·07
Calorific Value	*Calories*	5,674	5,609	5,348	6,900	*6,981*	-	*6,482*
,, ,,	*B. Th. U.*	*10,013*	*10,096*	*9,626*	*12,420*	*12,571*		*11,672*
Fuel Ratio . . .		*2·1*	*2·2*	*1·8*	*2·7*	*2·9*	*4·6*	*2·2*

(*Figures in italics are calculated.*)

1. Nkombedzi, Sample IX, 5 ft. seam.
2. Nkombedzi, Sample X, 6 ft. seam.
3. Nkombedzi, Sample XI, 5 ft. seam.
4. Tete Colliery, Portuguese E. Africa.
5. Wankie Colliery, Southern Rhodesia.
6. Natal Navigation Coal.
7. Witbank Main Seam, Transvaal

The Nkombedzi analyses were made on bulk samples taken from shallow pits, and samples taken at depth could reasonably be expected to be of better grade. Furthermore, if the washing process generally employed at South African collieries were applied to the Nkombedzi coals the ash content would be appreciably reduced, and the coals may therefore compare quite favourably with those worked successfully in other African coalfields. The present investigation has been confined to surface outcrops, and for a better assessment of the quality and quantity of coal available, it would be necessary to examine and sample the area systematically by means of boreholes taken at least to the limits of depth at which it would normally be practicable to mine the coal.

Bauxite.—Since 1939 the Anglo American Corporation of South Africa Ltd. has been investigating the bauxites of the Mlanje Plateau, and during 1943 the Geological Survey undertook a re-examination and detailed sampling of the deposits, as earlier opinions regarding the quantity and grade of the ore appeared to need revision. Sixty prospecting shafts were reopened, cleaned, and sampled by taking channel cuts 5 in. wide, 2½ in. deep and 5 ft. vertically. A total of 250 samples was taken and forwarded to the Imperial Institute for analysis. So far, states the Nyasaland report, 160 analyses have been received, and the average of these results is shown in the table on page 127. The bauxite as a whole has a high silica content, but most of the silica is usually present as quartz, which is easily removable by washing and sieving. Assuming that all the quartz could be removed, the resulting product would have the composition shown in the same table.

The 160 samples analysed are of several grades, the two of most value being: (*a*) bauxite of commercial grade in the raw state, with total silica less than 6 per cent. and alumina averaging 48·84 per cent., with a range of 37·59 to 52·84 per cent.; (*b*) bauxite amenable to treatment and yielding a product with less than 2·50 per cent. combined silica and insoluble silicates, and more than 50 per cent. alumina. The quantity of bauxite of these two grades is very large and quite sufficient to warrant careful consideration as a commercial commodity.

Raw Bauxite (Average of 160 Analyses)	*per cent.*
Alumina	41·56
Quartz and insoluble silicates (including silica 17·44 per cent.)	18·30
Combined silica from readily attacked silicates	1·29
Ferric oxide	14·02
Titanium dioxide	1·54
Loss on ignition	22·87
	99·58

Product after removal of 17·44% Quartz (Theoretical)	*per cent.*
Alumina	50·59
Combined silica and insoluble silicates	2·62
Ferric oxide	17·07
Titanium dioxide	1·87
Loss on ignition	27·84
	99·99

Cement.—Careful consideration has recently been given to the possibility of manufacturing cement from the clays of Lake Malombe. Earlier work had shown that materials suitable for the manufacture of Portland cement, natural cement and hydraulic limes occur on the floor of the lake in sufficient quantity to supply a small factory for about 50 years (see this BULLETIN, 1932, 30, 139-159). The results of the latest inquiries indicated that the great stumbling block was the lack of suitable fuel, of which large quantities would be required. At present neither coal, coke, nor charcoal are available economically. If, however, the Nkombedzi coals are worked the question of cement manufacture should be re-examined, especially if the River Shire is controlled so that water-borne transport becomes available.

T. D.

Lead in South Africa.—The outbreak of war in 1939 made it highly desirable that stock should be taken of the Union's mineral potentialities, especially of those minerals which are strategic in the sense that the country has been largely dependent on foreign sources of supply. The Geological Survey was instructed to concentrate its energies on such a stock-taking, and a volume recently received in this country entitled "Lead Deposits in the Union of South Africa and South West Africa, with some notes on associated ores," by J. Willemse, C. M. Schwellnus, J. W. Brandt, H. D. Russell and D. P. Van Rooyen (*Union of S. Afr., Geol. Surv. Mem. No.* 39, 1944) is a result of this policy. Not only was all previous information on lead ore production collated, but most of the known occurrences were specially examined and geologically mapped in detail, and in certain cases geophysical methods were used in the hope of making new discoveries or of proving an extension of a known deposit. The general conclusion arrived at is that the comparatively widespread occurrence of lead ores at and near the surface seems to justify further efforts to locate other deposits at depth; such efforts must be largely geophysical in character, and the Geological Survey is taking steps to obtain instruments best suited for the discovery of sulphide bodies.

The volume, from which the following notes are abstracted, is one of 179 pages, plus 23 plates, of which roughly two-thirds are devoted to the Union and one-third to South-West Africa.

Union.—The lead occurrences in the Union, about 50 in all, are described separately in detail, district by district, subdivided into two divisions: deposits in calcareous formations and deposits in formations other than calcareous. Each occurrence is systematically and uniformly described under the following headings: general geology, the ore deposits, genesis of the deposits, present activities, past production, ore reserves, geophysical measurements, conclusions. Assay results, mine plans and geological maps usually accompany the description of each deposit. Special reference is made to the potentialities of the various deposits, and in some cases possible future development is indicated. The geophysical work consists of magnetometric surveys, electrical resistivity measurements, and gravimetric surveys.

The replacement deposits in the Union form irregularly shaped bodies, veins or scattered grains of lead ore in the dolomite and chert of the Dolomite Series in the Transvaal and in the Hay division of the Cape Province. They are also found in limestones in the Uitenhage division. The chief ore mineral is galena; associated ore minerals are zinc blende, chalcopyrite, pyrrhotite and pyrite. The frequent association of vanadinite with secondary lead ores is noteworthy.

A feature of the majority of the replacement deposits in the dolomite, which is very important in so far as the location of new deposits is concerned, is the large-scale development of manganiferous earth accompanying the ore and formed at a later date. This manganiferous earth has probably arisen from leaching of the dolomite near the surface, a process which would be accentuated by the acids formed from the oxidizing sulphides.

The ore deposits in calcareous formations range from individual stringers to orebodies about 450 ft. in diameter and more than 200 ft. in depth, but lead minerals also occur as detached grains in the quartz or carbonate gangue. The stringers sometimes pass into veins, which on thickening give rise to pockets containing several tons of ore, and generally the orebodies consist of a number of such stringers, veins and pockets forming a stockwork. At certain occurrences the vein material fills the interstices between fragments of dolomite breccia. Very often the orebodies are pipelike in form; sometimes they are bedded deposits, but in many cases mining has not reached such a stage that the true form of the orebody can be ascertained.

All investigated occurrences of lead ore in non-calcareous rocks were invariably found to be vein deposits. The longest distance that one of these veins has been traced along the strike exceeds 5,000 ft., and the greatest thickness recorded in a vein is 14 ft. (on Dwarsfontein, 21.)

Lead deposits in non-calcareous rocks are found in widely separated areas and most geological formations ranging from the Old Granite to the Karroo System. The majority of these vein deposits are situated in the vicinity of the Bushveld igneous complex.

The known lead occurrences of the Union have almost invariably been discovered accidentally, and it is consequently considered hazardous to express an opinion on the subject of new discoveries. It is stated, however, that there is no cause to be pessimistic, and the following areas may still contain hidden concentrations of lead ore of economic importance.

(1) The strip of country occupied by the Dolomite Series forming the northern limb of the syncline of the Bushveld igneous complex in the Western Transvaal. This belt forms the counterpart of the Marico lead belt, and comparatively undeveloped deposits are present on the farms Genadendal 314 and Goedehoop 438.

(2) The dolomite country N.W. of Potgietersrust and that in the vicinity of Chuniespoort. These two areas fall within the contact aureole of the Bushveld igneous complex and by analogy with the Marico lead belt may have been mineralised with lead minerals.

(3) The ground occupied by the huge xenolith of the Transvaal System in the Bushveld igneous complex along the Crocodile River, N.W. of Brits. A few small occurrences in the dolomite of the xenolith may be indications of a more widespread lead mineralisation there.

(4) On the farm Dwarsfontein 21 and adjoining farms on both sides of the boundary between the Pretoria and Springs districts. There may still be undiscovered vein deposits here, but new discoveries are not readily made owing to the presence of a thick covering of soil and Karroo System. The application of geophysical methods in this instance has so far been fruitless.

The geological aspects which should be borne in mind by prospectors are also given.

A résumé of production from the various farms shows that the total of the average annual production of each occurrence of lead ore has been 1,374 tons, the total of the maximum annual production 4,411 tons and the total of the minimum annual production 480 tons, but in these totals the exceptional quantities produced at Dwarsfontein, which averaged 1,813 tons for 10 years and where the main occurrence is worked out, are omitted. Even the total of the maximum production of all the occurrences (4,411 tons of lead ore) is still below the annual consumption of just over 4,000 tons of lead metal in 1938. The actual production of lead ore concentrates in the Union in 1938 was only 78 tons. It is obvious that by exploitation along the same lines as in the past the known occurrences will in no way supply the local demand.

It is considered that the following factors will materially influence the future production of lead in the Union :

other mercury fields, the deposition of the cinnabar is associated with volcanic activity, and of this there are two known periods in the Kilkivan district.

Altogether, about 35 deposits of cinnabar are known to exist in this area, but only five of them were actually being operated at the time of making the report. Of these five, four are believed to be capable of increased output. These are the deposits on Mining Lease 108, that of Queensland Quicksilver, Ltd., and two on Mining Freehold 1886. In addition, five properties not being worked at present are considered to be worth re-opening and one unworked lode is believed to be worth developing.

Even with an increase in their activities, it is not thought that the five deposits now being worked could yield more than 10 tons of mercury a year.

In addition to these lode deposits, there is also, on Mining Lease 108, a relatively large deposit of low-grade ore, estimated to contain, down to 20 ft., 7,000 tons with a mercury content of 2 lb. per ton, but a great deal of work would be necessary to prove whether this deposit could be economically operated, even with mercury at the very high price of 22*s.* 6*d.* per lb. locally. A certain limited amount of open-cut work has been done on this occurrence from which, however, it seems by no means certain that the average tenor will approach 2 lb. per ton, *i.e.* 0·1 per cent. of mercury.

E. R. V.

Copper Reserves of Newfoundland.—Copper mining in Newfoundland dates back as far as 1778 when efforts were made to work certain complex sulphide ores at Shoal Arm. Since that time, numerous deposits have been located and developed, especially at Terra Nova, Tilt Cove, Betts Cove, Little Bay, Gull Pond, Twillingate and Buchans; and in recent years production has been of the order of 8,000 tons (in terms of metal). From 1854 to 1919 the value of production of ore, regulus and ingots has been estimated at about $18 million.

In accordance with its policy of making detailed investigations of specific mineral resources, the Newfoundland Geological Survey in 1938 and 1939 made a careful examination and inventory of the copper resources of the island, with a view to determining the possibility of resuscitating an industry which half a century ago occupied an important place in the economic life of Newfoundland. The results of this examination are set out in Bulletin No. 20 of the Geological Survey, entitled "Copper Deposits of Newfoundland," by G. V. Douglas, D. Williams, O. N. Rove and others, who conclude that although the discoveries so far made do not indicate any very large bodies of ore, there are, nevertheless, a number of bodies of one to five million tons. The following tabulation is given by the authors in respect to the known reserves.

Copper Reserves of Newfoundland

Mine or Prospect.	Reserves (short tons)	Copper. %	Copper content (lb.)
Buchans . . .	4,500,000	1·5	135,000,000
Gull Pond . .	2,160,000	2·62	113,000,000
Pilleys Island :			
Mine . . .	225,000	3	13,500,000
Dump . . .	?		
Tilt Cove :			
West Mine . .	?		
West Mine Dumps	110,000	2	4,400,000
East Mine . .	25,000	3	1,500,000
East Mine Dumps	145,000	1·5	4,350,000
Little Bay :			
Mine . . .	?		
Dumps . .	200,000	1·5	6,000,000
Baie Verte :			
Mine . . .	?		
Dump . . .	20,000	2·5	1,000,000
Total .	7,385,000		278,750,000

E. H. B.

Geophysical Survey Work in Ontario.—A stage has been reached in geophysical survey work where a number of methods have become accredited to a varying degree under various conditions and some very sensitive instruments have been developed to apply these methods. In the case of ore deposits, the geophysical indications can be tested by drilling and by mining. In other cases much remains to be done in the close comparison of the geophysical results with the information obtainable by normal methods of geological survey. A further aspect of importance is the applicability of a particular method to a special type of problem under varying topographical and climatic conditions. But in all cases it is generally agreed that the closest collaboration of the geologist and geophysicist is required, not only in the final interpretation of the results, but where the geological structure is at all complicated, at most stages of the conduct of the survey.

For these reasons the " Review of Geophysical Work Carried out by the Ontario Department of Mines, 1937-1944," by A. A. Brant, recently issued by that Department, is particularly opportune and important and the subject matter of the remainder of this note is taken from it.

Geophysical survey work was begun by the Ontario Department of Mines in the summer of 1937. Magnetic, electrical resistivity, self potential, and gravimetric surveys have since been conducted.

Magnetometer.—Magnetometer surveying in general will enable most rock formations to be differentiated even though differences in their magnetic properties are slight, *e.g.* lavas, tuffs, and limestones could be differentiated at Steeprock Lake ; lavas and greywackes at Little Long Lac; and pre-Cambrian lavas and sediments in the Kirkland-Larder area, although the highly carbonatised rocks within the "break" could be differentiated only with difficulty or not at all.

Magnetometer surveying is in general an aid to geological and structural mapping and provides a means, in many cases, of obtaining a sub-outcrop map. It is not a direct means of mineral location unless the mineral bodies sought are magnetic or associated with some magnetic mineral or rock. As examples, gold deposition in the Pickle Lake and Little Long Lac areas is commonly associated with iron formation, and the pyrrhotite ores of Sudbury are magnetic.

The standard procedure of magnetometer surveying is well developed and quite widely applied, and a sensitive highly-developed instrument, the Askania type, is in general use. It is at present being manufactured in Toronto, although the cost puts it out of reach of most individual explorers.

It is assumed that magnetic work would be more widely practised if the art of interpretation were more generally understood. A highly applicable (except in certain exceptional cases), simplified procedure of interpretation is being developed and tested.

Electrical Resistivity.—Electrical resistivity methods have in general been applied to the tracing of conductors represented by shear or mineralised zones. There are several variations to the method, but all have in common the energising of the ground by current and the measurement or comparison of successive drops in voltage between metal exploring stakes moved along a traverse.

The work at Steeprock Lake showed that the electrically resistant hæmatite body could be traced by working through the ice. Certain fluorspar veins in the Madoc area were found to be associated with zones of pronounced fracturing in limestone. These are characterised by decreased resistivity. One new vein was thus predicted, and the extension of others indicated. The shear zone marking the Larder Lake "break" was indicated by decreased electrical resistance at the Omega, Barber-Larder and Chesterville mines, where tests were made.

The use of electrical resistivity methods has been much more restricted than magnetic methods, owing to less applicability, the cumbersomeness of equipment, and the marked anomalies occurring at rock-muskeg boundaries, which makes the delineation of anything in the vicinity uncertain. A new field set-up, involving much less wire and movement of generator leads and a simple mathematical means of correcting for surface effects, has been developed during the past year and will be discussed in this year's report.

Self-potential.—Self-potential measurements are made of the voltages arising from the action of chemical oxidation at sulphide bodies, or from the resulting change in concentration of underground waters in a shear zone or fault. For example, the Larder Lake "break" at Barber-Larder and for about a mile eastward contains sulphides and gives rise to a considerable self-potential anomaly.

In many cases a self-potential survey can indicate the presence of even sparse sulphides beneath moderate depths of overburden. A muskeg, however, may reduce the anomaly by 5 or 10 to 1.

Self-potential surveys are now seldom made, though they are rapid, cheap, simple to execute, and not infrequently extremely helpful.

Electromagnetic.—Electromagnetic methods, involving the generation of an electromagnetic field at frequencies of sixty to a million cycles and the measurement by means of a pick-up coil of the effect of the resulting currents induced, have not been tried as yet by the Ontario Department of Mines. The main difficulty with these methods is the extreme anomalies caused by surface conductors, such as muskegs and swamps, and the fact that any mineralised zone to be indicated must be heavily mineralised. These methods, however, are of interest as being useful and quick to apply in areas of shallow, dry overburden and as being the only ones in addition to the magnetic capable of being operated in winter (apart from resistivity work on frozen lake surfaces).

Gravimeter.—Gravimeter measurements, making use of the increased gravitational pull caused by formations of greater density, have been tried only twice in the pre-Cambrian. Broad formations are necessary to cause appreciable anomalies. Their use, however, to predict deep intrusions, etc., in areas thoroughly surveyed geologically should not be lost sight of. The readings would be little influenced by the general Northern Ontario topography.

As regards gas exploration, the experience in South-Western Ontario shows that gravimeter work is best applied when it is thought that large basement blocks are associated with the formation of the gas or oil structures.

Seismic.—Seismic methods have not been tried in the pre-Cambrian in Ontario because of the cumbersomeness of equipment, difficulty of applying surface layer corrections, high cost, and very limited applicability. Special problems, however, may arise where trials might be made to advantage, *e.g.* the thickness of the cobalt sediments east of Larder Lake.

Chemical Analyses.—The widespread chemical analyses of soils and the measurement of lake and river conductivities have been suggested as refinements of " float " prospecting to localise broadly areas of mineralisation. As little experimental work is at hand by which to judge the usefulness of these proposals, final conclusions as to their efficacy must be postponed till time provides sufficient widespread observations. It is doubtful if they will serve, however, to locate mineralisation in areas of considerable overburden, such as characterise Northern Ontario.

Radio-activity.—Measurements of the surface radio-activity by the varying gamma radiation of rocks and veins are limited by the fact that 5 ft. of drift is practically sufficient to obscure the most radio-active vein.

General conclusions regarding the status of geophysical methods to date are as follows:

(1) Magnetic measurements are generally applicable at all seasons. The procedure is simple, but the approach to interpretation should be and can be much simplified to stimulate broader usage.

(2) Electrical resistivity measurements have specialised seasonal application but are at present infrequently used. The development of a simplified standard operating procedure and approach to interpretation would be of great aid.

(3) Self-potential methods are direct and simple to apply and interpret. They have only seasonal application. They could well be much more widely used than at present.

(4) Electromagnetic methods have only very local applicability to cases where marked contrasts in conductivity exist under dry overburden. The measurements can be carried out in winter.

(5) Gravimetric and seismic methods may have application only to certain special problems.

The limitations of geophysical methods are as follows:

All geophysical methods have only a limited applicability, owing to the fact that they lack depth penetration, the anomaly caused by a long tubular body decreasing roughly proportional to the depth of the body. Certain methods, the resistivity and the electromagnetic, are limited by the effect of surface features unless adequate corrections are found. The resistivity and self-potential methods cannot be operated in winter. Seismic methods are limited by cost and applicability.

The goal then can be little more than to provide a reliable sub-outcrop map. However, such a map may be very helpful in solving geological and structural relationships and in facilitating exploration by drilling.

The usefulness of geophysics can best be developed by:

(1) Simplifying and standardising procedures.
(2) Simplifying, standardising, and publicising the methods of interpretation.
(3) Establishing what can be done in the various areas.
(4) Research: (*a*) by trying and reporting on new methods in order that operators may be informed at an early date of their possibilities and limitations; (*b*) by trying to develop methods of greater depth penetration, such as might be achieved, for example, by the use of the numerous drill-holes in many areas; (*c*) by trying to overcome the shortcomings of some of the present methods, *e.g.* electromagnetic; (*d*) by trying to develop methods applicable in winter; (*e*) by compiling regional results in order that the full eventual usefulness of the cumulative results may be realised.

A. W. G.

The Opencast Working of Ironstone and Coal in Britain.

Ironstone.—A privately circulated " Memorandum Dealing with the Working of Stratified Ironstone of the Jurassic System in England," published by the National Council of Associated Iron Ore Producers, 50 Meadow Road, Kettering, is a very concise yet interesting and informative summary of the subject from which the first part of the following notes is abstracted.

As is well known, the great bulk of the Jurassic ironstone in England is worked opencast, but the memorandum contains some important remarks on the existence of underground mining and the degree to which the necessity for underground as distinct from opencast working will become necessary in the future. Thus, production from the Frodingham Ironstone of North Lincolnshire has, up to the present, been obtained from opencast operations and will continue so for some years. However, underground mining is being seriously considered and operations by this method have commenced. There are still some areas to be developed by opencast methods in the Northampton Sand of South Lincolnshire, Leicestershire and Rutland, but we are told that the time is not far distant when some of the operations will have to be carried on by underground mining. With regard to the Marlstone of South Lincolnshire and Leicestershire, a large proportion of the ore obtainable by opencast methods has now been worked and it is doubtful whether underground working will be resorted to. In the case of the Northampton Sand there are further areas available for working by opencast methods, but there are also considerable areas where the ore will have to be won by underground mining.

The output figures show the great wartime achievement whereby the total production of Jurassic ores (including the Cleveland district) was increased from 10,726,000 tons in 1938 to 17,415,000 tons in 1943. Output of other British iron ores in 1943 was only 1,079,000 tons.

With regard to yield, the statement is made that as a general guide it may be taken that the yield per foot of thickness per acre varies between 2,000 and 2,500 tons.

A short section briefly summarises the position as regards minimum rents, royalties, surface rents, compensation to agricultural tenants, and restoration of the surface. The sections of particular interest to most readers will doubtless be those describing, with the aid of plates, the present methods of mechanical working, followed by a discussion of the problem of dealing with the restoration for agricultural use of the worked-out areas.

Whereas very little difficulty was experienced in the development of opencast workings from the outcrop, we are told that " the exhaustion of such areas in the not far distant future will necessitate the driving of initial gullets or cuttings from 40 to 50 ft. deep in the overburden ; such development will create serious problems, as the greater proportion of the material excavated will have to be taken away and tipped. This may result in the levelling of certain unrestored areas."

"At the present time the maximum depth of overburden being dealt with in baring ironstone is 82 ft., but by improved mechanisation under certain conditions, producers may be enabled to work at a greater depth by opencast methods. All but the deeper areas are quickly becoming exhausted, and within a short time further underground operations may have to be started if an adequate supply of ironstone to meet the national requirements is to be maintained. The opening up of every underground mine brings in its train many problems such as the provision of skilled miners and the necessary housing and services for them."

An important statement is made concerning reserves. The most recent estimates, those of the Kennet Report, 1939, gave 108,800 acres (excluding Cleveland), but only a part of these 108,800 acres has been systematically explored, and in many areas in the Midlands chemical analysis indicates that the beds are commercially valueless, at any rate at present. Furthermore, it is impossible to convert acreage figures into tonnage reserves owing to the very large variations in the thickness of stone which can be worked. For these reasons the Memorandum concludes that it is not possible for any reliable estimate to be made of the tonnages available for working.

Another recent publication on this subject is a paper entitled "The Opencast Mining of Ironstone and Coal," by W. D. Evans (*Geogr. J.*, 1944, **104**, 102-117).

In this paper the following systematised approach to the planning and working of opencast sites is claimed to result in a minimum expenditure of effort, and to provide the solution to most of the problems encountered in opencast mining of all kinds.

(1) Suitable sites are selected from the 6-in. geological maps of H.M. Geological Survey. These maps are available for the main part of the Jurassic ironstone field, and for all the coalfields in the country, with the exception of Somerset, which is now being surveyed.

(2) The selected site is investigated by the examination of existing outcrops followed by the digging of trial holes or trenches. If the mineral is not of a workable quality then the land is returned to the farmer.

(3) If the mineral is workable, then the site is further prospected by a series of boreholes put down at points selected by the geologist to provide the maximum amount of information. The level of the top of each borehole above O.D. is calculated, and the strata proved carefully recorded. Borehole samples of the mineral are also collected and analysed.

(4) Isopachyte plans of the site are then constructed to show the variation in thickness of the beds above the mineral, and of the mineral itself. These plans should be drawn to the same scale as that used by the engineer for his final layout of the mine.

(5) Contour plans of the top, or of the base, of the mineral should then be drawn on the same scale. These will show the disposition of the mineral at depth. This is necessary as frequently the variations in gradient of the deposit bear no resemblance to the topography of the site, and by means of these plans the engineer will be able to devise a drainage system for the pit before operations begin.

(6) Where the mineral shows great variation in composition, as in the case of ironstone, a plan showing the distribution of the main chemical constituents of the deposit can be constructed. This will assist in delineating the workable area.

From these plans it is possible for the engineer to determine the most advantageous position for the initial excavation, the type of machinery necessary to excavate the amount and type of overburden shown by the isopachyte plans, as well as how to negotiate successfully any discontinuities that may occur in the deposit. Further, plans can be drawn out at this stage to incorporate the restoration of the land, so that it can be effected with the minimum expenditure of time and money.

Some interesting remarks are made on the relationship of the chemical composition of the ore to its working. In the early days, only the more completely oxidised parts of the Frodingham Ironstone were extracted by selective hand-digging. Complete mechanisation was therefore impracticable until it was discovered that the Frodingham Ironstone could be profitably used as a ferruginous-calcareous flux in the smelting of the more siliceous Northampton Sand Ironstone, when selective hand-digging was replaced by a fully mechanised excavation of nearly the whole of the ore-bed. The Marlstone Ironstone is now largely used in the same way. In parts of Leicestershire, however, particularly in the Melton Mowbray district, the Marlstone Ironstone contains iron, silica and lime in such proportions that it is almost self-fluxing and is smelted as an independent source of iron.

The chemical composition of the ore is often related to the nature of the overburden. Most calcareous ironstones are not worth working unless they are oxidised. The Frodingham Ironstone is often largely unoxidised under relatively small thicknesses of Lower Lias shales, but it has been found workable even in this condition. The Marlstone Ironstone is usually unoxidised when the cover of Upper Lias shales reaches 30-40 ft., owing no doubt to their impervious nature. The ironstone has been worked under great thicknesses of cover where the overburden consists of glacial gravels and boulder clay, the ore having been largely oxidised prior to their deposition. The oxidation of the Northampton Sand Ironstone has been to some extent caused by the percolating waters, the entry of which into the ore-bed is controlled very largely by the permeability of the overlying strata. Naturally, this is also complicated by the circulation of underground waters in the ironstone, but in all cases attention is paid to hydrogeological factors when a site is being selected for opencast mining. Carbonate ores are calcined at or adjacent to the quarry.

Methods of removing the overburden and of working the ore are described as are also the methods employed in the restoration to agricultural use of land from which the ironstone has been extracted.

Less well known as yet perhaps are the geological structures recently described by officers of the Geological Survey (S. E. Hollingworth and others, "Large-scale Superficial Structures in the Northampton Ironstone Field," *Quart. J. Geol. Soc.*, 1944, **100**, 1-44), and the modifications in working which these entail.

The geological structure of most of the Northampton Sand Ironstone has been complicated by the effects of relatively recent large-scale superficial movements. As a result of these the beds of ironstone have frequently been lowered along slopes by movements induced within the clays of the Upper Lias during valley formation. The phenomenon is known as *cambering* and has given rise to the formation of fissures or *gulls* in the ironstone, generally roughly parallel to the contour of the land, and usually filled with sands, silts, and clays derived from the Lower Estuarine beds above. In areas, such as on the flat crest of a spur, or on well-graded valley sides, the cambering of the strata has developed an appreciable dip, and the beds are often dislocated by *dip-and-fault* structures. These consist of a series of parallel, steeply inclined, fractures between which the beds are tilted sharply downhill causing an appreciable downthrow on the uphill side of the dislocations. A step-faulted arrangement of the beds is thus formed in which the downhill dip of the strata largely compensates the throw of the faults. Gulls are almost invariably developed along these lines of dislocation.

Another result of superficial movements consequent upon valley-formation is what are known as *valley bulges*, which in their simplest form consist of anticlinal uprises of the material composing the valley floor, as a simple or compound fold, or a series of discontinuous elongated domes. Valley bulges are responsible for areas of outcrop stone that have led mining engineers to undertake much fruitless exploration, as such outcrops are always severely disturbed and of limited extent.

It is generally found advisable to excavate the ironstone as nearly at right angles as possible to the alignment of the gulls. In this way the ore can either be removed from between each pair of gulls by a dragline excavator, or that part of the gull which is exposed can be quickly dug out and dumped on one side by a power shovel. Further, if considerable thicknesses of limestone occur in the overburden it can be more easily excavated in this direction by a power shovel, as these beds have been loosened by the downhill cambering of the strata.

Where dip-and-fault structures are present the alignment of the working face parallel to the direction of the lines of dislocation takes full advantage of the loosening effects caused by the downhill tilting of the beds. Further uphill, however, the place of the dip-and-fault structure is taken by gulls.

Coal.—Whereas in the early days of coal-mining in this country only the outcropping and near-surface seams were worked, at the present time the collieries are mostly situated well to the deep. However, the sudden demand in 1941 for an increase in the home output of coal coincided with a shortage of skilled miners and led to the development of near-surface coal by opencast methods. When this scheme was first suggested during this war it seemed as if the coal industry had wisely considered outcrop coal to be a vanished asset. " Fortunately, however, a thorough investigation was made, and some districts have proved amazingly fruitful, especially in the Notts.-Derby and Yorkshire fields, where the ' old men ' had spared an unexpected proportion of near-surface coal." (E. B. Bailey, " The Natural Resources of Great Britain," 1944, Cantor Lecture, *J. Roy. Soc. Arts*, 1944, **92**, 538-545).

Although the geology of the British coalfields is far more complex than that of the Jurassic ironstone field, precisely the same geological considerations and methods of approach are applicable to the opencast mining of near-surface seams of coal. Generally speaking, seams less than 3 ft. thick are not excavated unless they occur above a thicker seam. Sites are only worked where " the ratio of overburden to coal does not greatly exceed 5 to 1 " (K. C. Appleyard, *J. Inst. Fuel*, 1944, **17**, 78).

This great project was handicapped at the outset by a shortage of suitable mechanical excavators, but by the end of April, 1944, the output totalled 7,552,000 tons.

In the South Wales Coalfield the possibilities of working coal in opencast pits is seriously limited by the Pennant Sandstone, which overlies the main productive part of the Coal Measures. In the Forest of Dean there are no suitable sites. In the Midland coalfields, where the principal areas are already being worked opencast, the workings are complicated by the rapid variation in the thickness of the seams, steep dips at outcrop, and by the presence of small faults dislocating the seams. The Notts.-Derby and Yorkshire field on the other hand has seams which frequently dip at low angles, and are not seriously affected by faults. As a result, many successful sites have been developed in this field, and the bulk of the output of opencast coal has been obtained from it. Opencast coal has also been obtained from Scotland, but in general the geological structure of the Scottish coalfields is too complicated for the development of large opencast sites.

In all the coalfields the working of large opencast sites is restricted by the presence of old near-surface workings. In the absence of old plans it has been the sad experience of most opencast engineers in charge of sites to find old workings suddenly appearing in the working face of the pit. In some cases it has been found possible to extract the pillars of coal left in the old mine, but as a rule their presence leads to the abandonment of the site.

The quality of coal obtained from opencast pits is usually determined by the absence or presence of "dirt-bands" in the seam, and by the extent to which material from the overburden is prevented from contaminating the coal as it is being excavated. In the early days the quality of the coal was belittled, in some cases justifiably, but with improved mining methods and the installation of screening plant and washeries, a reasonably high-grade fuel is now being produced. It has not been appreciated that to keep the coal clean as wide a bench as possible should be maintained below the face of overburden. It has not always been possible to do this, owing to the lack of dragline excavators possessing a dumping radius great enough to leave room for the bench of coal.

Owing to the discharge of the excavated overburden on to relatively steeply inclined areas of worked-out ground, great difficulty has been experienced, particularly during winter months, in preventing it from subsiding into the workings. To overcone this, a much lower angle of rest for the discharged material must be allowed, which calls for a much wider reception area than is the case in ironstone pits. Large excavators must therefore be employed, and care must be taken in the layout of the mine to provide the widest possible excavation at the outset.

All sites excavated by the Directorate of Opencast Coal Production are fully restored to agriculture at the end of the mining operation. The sites so far exploited have been relatively small, and the amount of overburden removed has rarely been more than 60 ft., so that the land has been restored to the farmer after a period of nine to eighteen months. The results of restoration have been extremely good, as no expense has been spared to redeem the former quality of the land. In many cases the land has been improved as the results of excavation, and, frequently, variations in the former contour of the ground have been smoothed out.

A detailed example is given of the systematic planning and working of an opencast coal mine. The illustrations, particularly the block diagrams showing the methods of opencast working, are excellent and add greatly to the value of this paper.

A. W. G.

BOOK REVIEW

Books for review should be addressed to "The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

STEELPLANT REFRACTORIES: TESTING, RESEARCH AND DEVELOPMENT. By J. H. Chesters. Pp. xi + 509, 9 × 6. (Sheffield: The United Steel Companies, Ltd., 1944.) Price 36*s.*

This pioneer work is the first comprehensive and authoritative text-book on steelplant refractories so far published, and undoubtedly marks an important epoch in the development of metallurgical technology. The work summarises the conclusions reached over the past ten years by a group of outstanding research workers in the Refractories Section of the Central Research Department of the United Steel Companies, Ltd., a section which came into existence as a result of the far-sighted policy of the directors, who decided that their expenditure of some £500,000 per annum on refractories warranted a greater measure of scientific control than had hitherto been shown. The section has made tests on bricks used in almost every type of steelplant furnace, in addition to those employed in blast furnaces and coke ovens. It has also carried out liaison research with the Steetley Lime and Basic Co., Ltd., the Oughtibridge Silica Firebrick Co., Ltd., and Thomas Marshall & Co. (Loxley), Ltd., on the development of dolomite, chrome-magnesite and carbon bricks respectively. A study has also been made of the practice of other steel companies in this country, as well as in America and Germany.

Dr. Chesters, the author of the present work, is the Chief Adviser on Refractories to the United Steel Companies, Ltd., and a member of its Central Research Department. He presents his data in 14 well-illustrated chapters and 21 useful appendices, together with an author and a subject index, each chapter being provided with a selected and classified bibliography. The author observes that steelplants consume approximately one-half of all the refractories manufactured, involving them in an expenditure of about 5*s.* per ton of steel produced, yet relatively few of them have a refractories section in their research department and even fewer attempt to apply acceptance tests. He proceeds, therefore, to enumerate and describe the tests that have been found useful in evaluating these refractories, namely, apparent porosity, bulk density, apparent and true specific gravity, cold crushing strength, permeability to air, after-contraction or expansion, cone melting point, refractoriness-under-load, thermal shock resistance, slag resistance, microscopical examination and X-ray examination. This is followed by a short statement on the statistical treatment of test data, the few examples chosen being merely intended to arouse the interest of those who have not yet made use of this fascinating method of study.

The author then discusses in fair detail the various refractories concerned under five specific heads, these being (1) Silica and Semi-silica; (2) Magnesite; (3) Dolomite; (4) Chrome and Chrome-magnesite; and (5) Alumino-silicates. He mentions the highly controversial aspects of hot face insulation and backing insulation, and lays emphasis on the choice of the right material when once it has been agreed that insulation should be applied. Brief notes follow concerning such insulating materials as diatomite, clay, silica, asbestos, vermiculite, special alumino-silicates, and "experimental basic" obtained by foaming magnesite and chrome magnesite batches.

The remaining portion of the book deals with the practical side of refractories in actual use, and takes the form of a detailed account of the basic open hearth furnace both above and below the sill-plate level, the acid open hearth furnace, acid and basic bessemer converters, the electric steel plant, soaking pits and reheating furnaces, and the casting pit.

Altogether the work is well conceived and illustrated, and the author is to be congratulated on the production of an excellent and timely text.

E. H. B.

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EMPIRE EDUCATIONAL FACILITIES

EXHIBITION GALLERIES, LANTERN SLIDES, FILMS, LECTURES, Etc.

NOTES

Exhibition Galleries.—During the greater part of the six months which have elapsed since these notes last appeared (this BULLETIN, 1944, 42, 312) it was deemed prudent to continue the twofold policy (*a*) of keeping the Galleries closed to the general public, yet (*b*) at the same time making them accessible to any individual visitors sufficiently interested to make personal application at the Inquiry Office for admittance and to organised parties calling by arrangement. Every day there has been a number of individual visitors, but the bulk of the 6830 persons who visited the Galleries during the period under review has consisted of members of organised parties which continue to take full advantage of the facilities accorded them, namely of visiting the Galleries at any time mutually convenient. The number of visiting parties during the six months was 154, United Kingdom and Allied Troops preponderating with a total of 86, closely followed by Schools and Youth Organisations (56); Learned and Empire Societies came next (9), while Colonial and foreign evacuees dwindled significantly to 1 with Miscellaneous at 2.

Most of these visits have taken the form of an hour's tour of the Galleries, or of a particular Empire Court in which the visitors were specially interested, followed by a display of films in the Cinema appropriate to the occasion. In almost every case, the parties were accompanied by an officer of the Imperial Institute who, after a general introductory talk on our aims and work, conducted the visitors through the required section of the Galleries, pointing out and explaining exhibits of especial interest. The success achieved by this method of working has been so great that several Commands, notably units of the Indian and Canadian Armies, the W.R.N.S., the Royal Artillery, the Army Basic Education School, and the Air Training Corps, have made weekly bookings which extend for some months ahead.

With the cessation of hostilities in Europe and the return to London of her evacuated schoolchildren, it is to be hoped that the Exhibition Galleries may soon revert to the full pre-war practice of all-day and every-day opening. For the present such an extension is prevented only by lack of "man power" for the adequate wardening of the exhibits and the control of the many hundreds of interested youngsters who would be attracted by the reopened doors. However, demobilization will probably soon restore the happier and healthier conditions which existed pre-war and enabled the Institute to maintain an adequate and efficient patrolling staff.

During the period under review, the Empire Courts have received their usual quota of Colonial Service officers home on leave. A list of them appears on pages 175-177.

Among distinguished visitors who have been received by the Director and have made tours of the Galleries or have visited a particular Court are:

January 10: Dr. R. W. Vaughan, Chairman of the Mauritius Institute.
March 28: H.E. the Rt. Hon. Sir Reginald Dorman-Smith, G.B.E., Governor of Burma.
April 20: The Hon. Sir Htoon Aung Gyaw, Burmese Adviser to the Governor of Burma.
May 11: Sir Giles Gilbert Scott, O.M., R.A., Member of the Crown Lands Advisory Committee.
May 12: Mr. G. Spencer Summers, M.P., Secretary of the Department of Overseas Trade and President of the Board of Governors of the Institute.

The Imperial Institute and Mauritius.—On the occasion of a recent visit to the Imperial Institute, Dr. R. E. Vaughan, of the Mauritius Department of Education, Chairman of the Mauritius Institute at Port Louis, expressed a desire for a small display which would outline to visitors to the Port Louis Institute the main aims of the Imperial Institute in London. The layout of the display submitted, though attractively conceived, was substantially a concise statement of fact, and, as such, its main captions are reprinted below for the information of other interested persons.

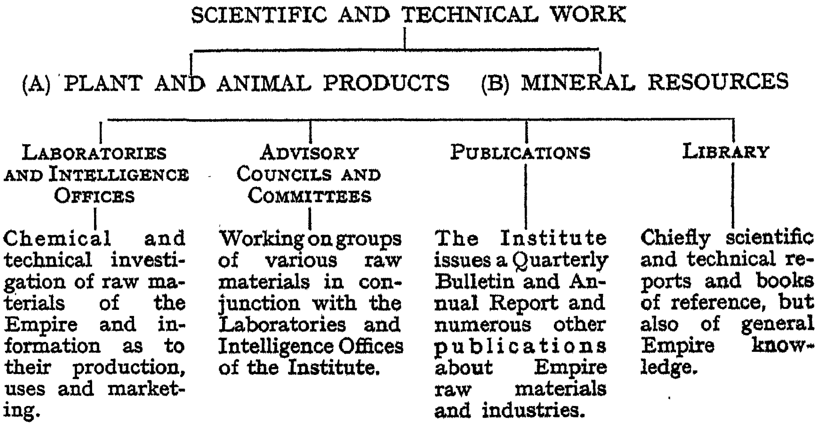
THE IMPERIAL INSTITUTE

The Imperial Institute was established in 1887 as a memorial of Queen Victoria's Golden Jubilee, to promote the industrial utilisation of the raw materials of the Empire and a better knowledge and understanding of life in the Overseas Empire. This exhibit shows the organisation of the Institute and some of its activities.

PLATE V.

A View of the Mauritius Court in the Exhibition Galleries of the Imperial Institute.

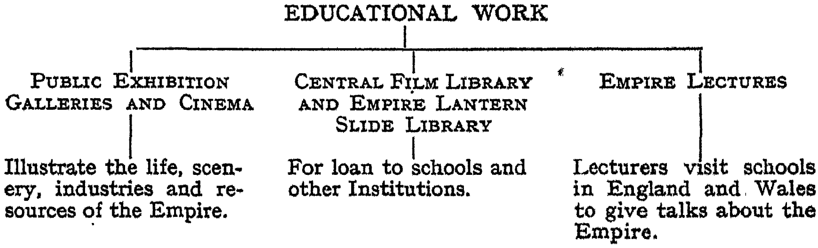
[facing page 161



SCIENTIFIC AND TECHNICAL WORK

- (A) PLANT AND ANIMAL PRODUCTS
- (B) MINERAL RESOURCES

- LABORATORIES AND INTELLIGENCE OFFICES
  - Chemical and technical investigation of raw materials of the Empire and information as to their production, uses and marketing.
- ADVISORY COUNCILS AND COMMITTEES
  - Working on groups of various raw materials in conjunction with the Laboratories and Intelligence Offices of the Institute.
- PUBLICATIONS
  - The Institute issues a Quarterly Bulletin and Annual Report and numerous other publications about Empire raw materials and industries.
- LIBRARY
  - Chiefly scientific and technical reports and books of reference, but also of general Empire knowledge.



EDUCATIONAL WORK

- PUBLIC EXHIBITION GALLERIES AND CINEMA
  - Illustrate the life, scenery, industries and resources of the Empire.
- CENTRAL FILM LIBRARY AND EMPIRE LANTERN SLIDE LIBRARY
  - For loan to schools and other Institutions.
- EMPIRE LECTURES
  - Lecturers visit schools in England and Wales to give talks about the Empire.

The layout, as supplied to Dr. Vaughan, included four enlarged photographs showing respectively an exterior view of the Imperial Institute, a general view in the Exhibition Galleries, a close-up of part of the Mauritius Court, and a corner of the Laboratories. The photograph of the Mauritius Court was specially taken by Mr. J. Allan Cash of the British Council and is here reproduced (Plate V) as exemplifying one of the Colonial Empire Courts and as illustrating several of the display items which are common to all of them.

On the wall are seen two framed artist's originals for Empire Marketing Board posters, showing respectively the cutting of sugar cane and the opening of coconuts, and between them hangs a silk banner on which are embroidered in appliqué work the Arms of the Colony. To the right the Arms are repeated in the form of a heraldic shield, and below this, almost hidden by the pedestal of the statuette, is a set of book-form swing frames in which a collection of photographs permits the visitor to make a pictorial tour of the island.

Against the wall are two dioramas, illuminated picture models, so vividly executed that they almost take the visitor to the Colony itself. The nearer one gives the view of Port Louis as seen from a steamer entering the harbour and the further one depicts a typical sugar estate, showing the principal field operations employed in the production of sugar cane, the Colony's chief crop. Standing between the two dioramas is a wall case in which is traced out, with sequences of specimens, photographs and samples, the whole story of Mauritius sugar, from the planting of the cane, right through to the shipment of the finished sugar.

In the centre case, jutting into the picture from the left, is a somewhat similar story dealing with Mauritius hemp, showing how it is grown, how the fibre is obtained, how this fibre is converted into twine and sacking, and how the latter is made into sacks for the shipment of sugar. This case also contains stories of other Mauritius crops and products, such as pineapples, cassava, spices, coconuts and tobacco.

Finally, standing on the steps to the right and surveying the whole Court is the statuette of Count Mahé de Labourdonnais, the Frenchman who did so much for Mauritius in her early days.

The Colonies Exhibition at the Imperial Institute.—During the past year a Colonial exhibition, jointly sponsored by the Colonial Office and the Ministry of Information, toured the principal cities of Great Britain, its main purpose being to make the Colonial Empire more of a living reality to the people of this country than are the impressions which they normally obtain from the press and the radio. In the words of the Duke of Devonshire, who performed the London opening, the exhibition provided "a picture in miniature of the 63 million inhabitants of the Colonial Empire for whose welfare we in this country are responsible." Staged in two sections, the first dealt with the war effort of the British Colonies; it emphasized the many and varied activities in which the Colonial peoples have played their part, and paid tribute to their devotion and self-sacrifice in the Allied cause. The second section portrayed the many social and economic problems with which the Colonial peoples are confronted; problems which, with our sympathetic help, must be solved before these peoples can take their rightful places as self-governing communities within the British Commonwealth and Empire. A sense of public responsibility in these matters cannot be too widely realized, and so, at the close of the original exhibition, arrangements were made for this section to be transferred to the Imperial Institute for a further period of publicity, and it has now been installed in the Exhibition Pavilion, adjacent to the Empire Cinema.

The nine subjects with which it deals fall broadly under the headings of Government, Labour, Material Resources, Law and Justice, Education, Higher Education, Agriculture, the War against Pests, and the Fight against Disease; the main "story" behind each is traced out by means of diagrams and vigorous captions, supported and forced home by carefully selected photographs and occasionally by specimens; each set being mounted on a series of decorative screens. Visual appeal is obtained mainly by variations of design, colour, and typography, but the following résumé of the principal captions will serve to show the manner in which each subject is treated.

GOVERNMENT

Development of Political Responsibility

The countries of the British Colonial Empire stand at every stage along the road to self-rule. Some are administered directly by British officials, under the Governor. Others are virtually self-governing, except for their external affairs. There is no rigid pattern for all territories. Each system has been shaped to fit local conditions. But the ultimate aim is the same for all: self-government within the framework of the British Empire.

This is how a typical Colonial Government works:

THE GOVERNOR. He is appointed by the King on the advice of the Secretary of State for the Colonies. Generally, but not always, he is promoted from the ranks of the Colonial Service. His main task is to direct the Administration and to interpret British Colonial policy in the territory to which he is appointed.

THE COMMANDER-IN-CHIEF. The Governor is at once chief executive officer, and the representative of the King. He is also Commander-in-Chief of the internal armed forces, and in certain Colonies exercises actual operational command.

THE EXECUTIVE COUNCIL. Governors are assisted by Executive Councils, to which senior officials of the Colonial Government, such as Chief Secretary, Financial Secretary and Attorney-General, always belong. In most Colonies, two or three unofficial members are nominated to the Council by the Governor to represent important interests among the people.

THE LEGISLATIVE COUNCIL. These make all laws, and debate and pass annual budgets. On them sit officials—heads of the more important Government Departments—and unofficials, both elected and nominated, representing the people. In certain Colonies, officials hold the majority; in others the unofficials outnumber official members.

PROVINCIAL ADMINISTRATION. The Governor, as Chief Executive, controls the Colonial Service, which staffs the Administration. Many Colonies are divided into Provinces, with a Provincial Commissioner or Resident in charge of each. Under him are District Officers who represent the Government in every area, and technical officers of the various Departments.

THE CHIEF SECRETARY. The Governor's chief of staff is the Chief Secretary (or Colonial Secretary), the head of the Civil Service. He presides over the Secretariat, the central organ of government, and is the link between the Colonial Office and the local Administration. The Chief Secretary generally becomes Acting Governor when His Excellency is absent from the Colony.

THE FINANCIAL SECRETARY. He corresponds to our Chancellor of the Exchequer, and is head of the local Treasury. One of his main duties is to frame the annual budget and steer it through the Legislative Council. He is a member of the Governor's Executive Council, and advises on all financial matters.

THE ATTORNEY GENERAL. He is the head of the Legal Department, which drafts all new laws and amendments that the Government wishes to introduce. He is also director of public prosecutions. But he does not control the judges. They belong to the independent Colonial Legal Service, whose senior member is the Chief Justice.

THE TECHNICAL DEPARTMENTS. These correspond roughly to our Ministries, and are staffed by experts. The most important are those dealing with Health, Education, Agriculture, and Public Works. Others look after Veterinary, Forestry, Customs, Lands and Survey, Labour, and other matters. Their Directors are officials of the Government, and generally sit on the Legislative Council.

THE DISTRICT OFFICER represents the Government among the people, and interprets the people to the Government. He knows every village in his area, and discusses with Headmen and Chiefs the local application of Government orders. He is the link between the man in the bush and the Governor in Council—the lynch-pin of administration.

THE ROAD TO SELF-GOVERNMENT. British policy is to train Colonial peoples in the difficult art of self-rule. This can best be done through the development of local government, which it is our aim and endeavour to encourage.

LABOUR

Improvement of Working Conditions

SMALL FARMERS form the bulk of Colonial workers. Only a small proportion of the Colonial peoples, perhaps three out of ten, work for wages, and most of these labour on farms and plantations. Industrial life affects only a small minority.

INTERNATIONAL LABOUR ORGANISATION. Over 25 International Labour Conventions have been ratified by the United Kingdom Government, which reports annually to the International Labour Office on their application to the Colonies. These Conventions protect women and children; they regulate hours; they deal with industrial accidents and insurances; generally they make a back number of the term "sweated labour."

Each territory has its own set of labour laws. Some, like Ceylon's, are advanced, nearly as well advanced as ours. Others, where conditions are still primitive, are sketchy. But the movement is always forward. To give one instance: since 1938 all but four territories have prohibited employment in industry of children under 14. The advance continues.

Labour Departments have many functions. They inspect factories and labour lines to enforce conditions of health and safety. They conciliate parties to trade disputes. They protect women and young workers; set up labour exchanges; strengthen labour laws; fight unemployment; and deal with workmen's compensation.

TRADE UNIONS. Workers in the Colonies are being helped by their Governments to set up Trade Unions. In 33 territories laws have been passed to authorise them. Nigeria, the Gold Coast and Sierra Leone; Cyprus, Ceylon and Mauritius; Trinidad, Jamaica and British Guiana; all have active Unions. Some, however, are too small and too sectional to fulfil their proper functions.

WORKMEN'S COMPENSATION. Workmen's Compensation laws have been passed in 30 territories. But agricultural work is only included, as yet, in a few cases. Barbados recently passed a law covering plantation workers, shop assistants and domestic servants as well as industrial employees.

TRAINING FOR SUPERVISION. Official policy is to train local people for jobs as Labour Supervisors. The Labour Department of Jamaica is staffed entirely by Jamaicans. Inspectors are being trained in Nigeria, Kenya and Fiji.

LABOUR ADVISORY BOARDS. Boards to settle wage disputes are being set up in many Colonies. In Jamaica and Barbados claims for higher wages made by cane-sugar plantation workers have been referred to bodies on which workers, employers and Government are represented.

INDUSTRIAL HYGIENE. Factory inspection is carried out in nearly all territories where factories exist. Special legislation to regulate health conditions has been passed in 11 Colonies.

MATERIAL RESOURCES

The Natural Wealth of the Colonies

A vast number of commodities are produced throughout the Colonial Empire.

In a large showcase below this caption is a display of 88 specimens of Colonial raw products, mainly cereals and other food grains, oilseeds, drugs and spices, gums and resins, beverage crops, minerals, and timbers.

The six principal products are selected for separate treatment, by larger samples and by the following captions.

RUBBER. Before the Japanese invasion of Malaya, the Colonial Empire led the world in its output of rubber. Ceylon is now the principal source of natural rubber open to the United Nations. Several of the British African Colonies have small areas of wild and plantation rubber; these are being developed, wild rubber is collected and neglected plantations are brought back into cultivation. The present rubber output of the Colonial Empire amounts to about 12 per cent. of British and American needs.

TIN. Again, before the Japanese invasion, Malaya and Nigeria produced two-fifths of the total world output of tin ore. The

Malayan tin was smelted at Penang or Singapore. Small quantities are also produced in Tanganyika, Uganda, Northern Rhodesia and Swaziland; ore and concentrates in these African Colonies are shipped overseas for smelting.

VEGETABLE OILS AND OILSEEDS. Copra (from coconuts), ground-nuts, and oil and kernels from the oil palm are important Colonial products. Coconuts are the most widely grown, especially in Ceylon, the Seychelles, Fiji and the Western Pacific. They are also grown in certain parts of Africa and the West Indies. Ground-nuts come from West Africa, where there is an intensive drive for increased production. The oil palm is grown extensively in West Africa.

SUGAR. Unrefined sugar is manufactured for local use in many Dependencies, but the higher grades for export come from Mauritius, the British West Indies, British Guiana, Fiji and East Africa. Factories have been increased and centralised. Certain by-products are well known, for instance the famous rum of Jamaica, and the fancy molasses of Barbados, which is very popular among Canadian lumbermen.

TEA. After India, Ceylon is the largest exporter of tea. Here tea marketing is a major industry employing many thousands of workers. East Africa also produces tea in large quantities. In some areas tea is "plucked" throughout the whole year, although there are important seasonal variations when, owing to monsoons, there is a far more abundant "flush" of leaves.

COCOA. Sixty per cent. of the world crop of cocoa is produced within the Colonial Empire. It is the principal export of the Gold Coast and Grenada, and a large export of Nigeria and Trinidad. There are usually two cocoa crops a year; north of the Equator the main crop season is from late September to late January; the light crop comes in about five months later.

PROCESSING PRODUCTS. Not only do the raw materials for a vast number of commodities come from the Colonies, but in some cases the Colonies also carry out certain stages of processing.

INDUSTRIAL RESEARCH. British and Colonial scientists are at work to improve industrial resources.

The Imperial Institute.—For over half a century the Imperial Institute has helped the Colonial peoples to develop the material resources of their countries by investigating, evaluating, and making known to merchants and manufacturers the various raw materials (animal, vegetable and mineral) on whose successful utilisation the prosperity of these peoples depends.

Colonial Products Research Council.—This Council was appointed in 1943 to develop the research programme and so raise the standards of living of the entire Colonial peoples. This work is undertaken for the welfare and prosperity of the countries concerned and their contribution to the world as a whole.

Lord Hankey is Chairman and Professor J. L. Simonsen, D.Sc., F.R.S., Director of Research. They are considering what greater use may be made of existing raw materials, and their by-products.

The Council aims at keeping in touch not only with scientists in the Colonies, Dominions, and India, but with their fellow-workers in foreign countries. It is hoped that a fruitful interchange of experience will come about, to the benefit of producers in all countries.

LAW AND JUSTICE

Each country in the Colonial Empire has its own code of law which is not invariably British. St. Lucia and Mauritius follow ancient French law in some respects; Roman-Dutch law is the common law of Ceylon; Cyprus law is partly based on the Turkish system. Mohammedan law is administered in many places. But underlying all these codes is the BRITSH IDEA OF JUSTICE. Where local laws conform to that, we have not made drastic alterations. But where local custom condoned practices abhorrent to British justice, then British law prevailed.

Legal systems are like a pyramid. At the top is the Supreme Court which hears the more important cases and appeals from the lower Courts. The broad base generally consists of Magistrates' Courts and in Africa Native Courts also. Often these Native Courts have more power than the Courts of British magistrates. In Africa, Chiefs and Headmen generally preside, without juries. British officials supervise their proceedings. These Courts try cases under native law.

Justice is administered in the first instance, as in Britain, by magistrates, often Colonial people who understand local problems.

Although in most territories the judges are mainly from the United Kingdom, an increasingly greater share in the administration of justice is being entrusted to the Colonial peoples themselves.

On the one hand local courts, entirely run by local people, are steadily receiving wider powers. On the other hand Colonials are trained for the highest judicial posts.

In Ceylon nearly all the magistrates and district judges and half the Supreme Court judges are Sinhalese as well as all the law officers. In the Gold Coast, Africans have been appointed to the Supreme Court as judges.

EDUCATION

The Fight against Illiteracy

Children in the Colonies need no compulsion to make them go to school. The problem is to supply enough schools. Government policy is to teach better farming, hygiene, housecraft and citizenship as well as literacy. In 1937, 3,300,000 children out of 10,500,000 in the Colonies were attending school. Every year new schools are being built and new teachers trained.

Education Departments in the Colonies spent £3,500,000 a year before the war. Other branches of Government also carried out education projects, and the Christian Missions contributed large sums.

A mass attack on illiteracy lies ahead. In many Colonies less than ten per cent. of the population can read or write. Desire to learn is widespread; shortage of money, teachers and equipment is the obstacle.

Education of adults is one of the biggest tasks of the future. Evening classes are held at many schools, but demand far exceeds supply. Teaching of better hygiene, food preparation, child welfare, and farming, as well as literacy, is part of the need.

The typical African elementary school is a simple "bush school" with African teachers. Most elementary schools are run by the Christian Missions. Because populations are scattered and money short, probably less than ten out of every hundred children attend schools in many parts of Africa.

Secondary schools have been established in all Colonies by Missions, Government and Native Authorities. Because distances are great, they are mostly boarding schools, like King's College, Budo (in Uganda). Only a very small proportion of African children as yet reach secondary schools, but bursaries help children of poor parents.

In all Colonies, agriculture is the basis of life. Gardens and farm plots are attached to many schools, and pupils learn the elements of better farming methods.

Education in better ways of living loses much of its effect if schoolchildren return to dirty and disease-ridden homes. Health Departments wage a continuous campaign to teach parents simple methods of hygiene, such as the use of latrines. Distribution of posters is one line of attack.

Girls' education has lagged behind that of boys. Fathers and elders often fear it may lead to the break up of family life. But these prejudices are fading, and the number of Colonial schoolgirls is growing every year.

HIGHER EDUCATION

Doors to New Worlds of Knowledge and Skill

Colonial colleges train the professional men and women who will lead their people forward to fuller lives and greater responsibilities.

The Secretary of State for the Colonies said in Parliament: "They will have to provide the agriculturists, the engineers, the doctors, the teachers, the veterinary surgeons, and the specialists and technicians which the approach to higher standards of life will entail."

The Law is one of the most sought-after professions, especially in West Africa, where fondness for litigation brings brisk business.

In the Gold Coast, African judges have been appointed to the Supreme Court.

THE TEACHING PROFESSION requires more and more candidates. In many Colonies these are recruited to training colleges from the higher elementary, middle or secondary schools. Training colleges have been established in Ceylon, Malaya, Hong Kong, Trinidad, British Guiana, Jamaica, West Africa and East Africa.

COLONIAL DOCTORS are trained in Ceylon and other Colonies. Students come from the West Indies, Africa and other regions to study at British schools for a full medical degree. Colleges such as Achimota (West Africa), Makerere (East Africa) and Suva (Pacific) train people in the preliminary stages of medicine.

AGRICULTURE is taught at all general Colonial colleges, such as Ceylon University, Achimota and Makerere, which turn out Agricultural Instructors and Research Assistants. The Imperial College of Tropical Agriculture in Trinidad trains expert staff for the whole Colonial Empire.

Higher education is expensive, and as yet only a very small proportion of Colonial youth go to college. In 1938 there were 200 Colonial students in Britain, about 5,000 overseas. British policy is to develop local colleges, to improve means of access to them, and to promote what Colonel Stanley described in Parliament as " intellectual lease-lend " between Home and Colonial universities.

AGRICULTURE

The Campaign for Better Farming

A large proportion of the inhabitants of the Colonial Dependencies are peasant farmers. Their methods are often primitive, crop yields are generally low, and soil fertility is quickly exhausted. The key to better living is better farming, leading to higher soil fertility and resulting in bigger yields and a wider variety of crops. Agricultural Departments try to bring this about by research plus widespread propaganda and patient preaching.

Agricultural Departments maintain experimental stations and laboratories where experts carry out research. They study plant diseases, methods of cultivation, how to maintain and improve soil fertility and, amongst many other activities, they select and breed improved strains of crops. They also train locally recruited staff who help to spread knowledge of improved farming methods which have been tested and proved to be sound.

One of the hardest jobs the agricultural staffs have to undertake is to convince the local farmer that these improved methods are really better than those he and his ancestors have used. Demonstration farms are established at suitable centres, school gardens may sometimes be used, enlightened cultivators are persuaded to set an example and Agricultural Officers and their Assistants tour the country giving advice.

Colonial crops fall into two main classes: export and subsistence. Export crops may be grown both on plantations and by native producers. Examples are rubber, tea, cocoa and cotton. Subsistence crops (for food) are almost entirely grown by peasant farmers and are immensely varied. Examples are the millets, maize, sorghum, cassava, rice, yams, sweet potatoes and sugar-cane.

Improvement of crops is an essential part of agricultural advance. Scientists provide new strains which resist disease. and which yield more. This is the job of the plant-breeder. When he has bred and tested a new strain, seed is produced in bulk and distributed to growers by Agricultural Departments.

Advance in the tropics is threatened by soil erosion, the process whereby good soil is carried away by water or by wind, leaving barren rock and subsoil. In America, erosion created the Dust Bowl. Millions of tons of fertile soil are being lost yearly in many Colonies. Results include falling crop yields, abandoned farmlands, dwindling rivers, poverty and hunger.

Serious damage is frequently caused to grazing lands by overstocking, particularly with cattle and goats, and by uncontrolled grazing. Water holes are usually few and far apart, and this leads to great concentrations of livestock near these holes and a consequent tramping out of pasture grasses. The soil, stripped of its cover, is thus easily washed or blown away. One remedy is to limit the flocks and herds, but this is not popular as stock owners reckon their wealth in terms of livestock. Much can be and is being done to improve the position by providing new wells and by encouraging rotational and controlled grazing.

War against Pests

Protecting Crops and Livestock

Millions of Colonial people depend for their very existence on the produce of their soil.

A plague of insects or infection among their cattle or crops could bring ruin to every family for miles around.

Together, British and Colonial scientists fight a constant war against the many scourges of tropical agriculture.

The war against pests and disease is never ending. It must go on until complete security for the Colonial farmer has been won.

No expense or trouble is spared to discover the causes of tropical diseases, and their cures. Research Institutions and Veterinary Laboratories have been set up both in Great Britain and in the Colonies, and experiments are going on all the time. Many Colonies have a Department of Animal Health, and thousands of pounds are provided for research work out of the Colonial Development and Welfare Fund.

Locally trained workers are playing an increasingly important part in research into the pests and diseases that menace the farmers of their countries. Trained in the schools and colleges now existing throughout the Colonies, they show an aptitude for this work and are of great assistance to the scientists from Britain.

THE FIGHT AGAINST TROPICAL DISEASE

Improvement of the people's health is a first aim of Colonial policy. Every territory supports its own Medical Department, staffed partly by British officers of the Colonial Medical Service, partly by locally recruited personnel. Since 1940, money for improved health services has been provided also from the Colonial Development and Welfare Fund.

The foundation of good health is the care of babies and their mothers. Government, Missions, Local Authorities and voluntary societies have set up hundreds of clinics in rural areas where mothers and babies go for advice and simple treatment, while nearly all hospitals have opened maternity wards.

One generation ago, superstition made African women afraid to have their babies in hospital, or to let their children attend. Now maternity wards are crowded, and mothers take their children to doctors for treatment, instead of to witch-doctors for charms and spells.

Ignorance and superstition are the two biggest enemies of good health in the tropics. Propaganda and general welfare work to improve sanitation and hygiene are at least as important as providing hospitals and medicines. In the Colonies especially, prevention is better than cure.

The building of clean, weatherproof houses is being encouraged in Uganda. Many native dwellings are made of rammed earth.

Traditional houses are generally makeshift and poor. Often they have no windows or chimneys, and the family share living quarters with goats and sheep. The Government builds model houses to show a better way.

Contaminated water carries the infection of dysentery, typhoid, bilharzia, guinea-worm and many other diseases. Clean wells are one of the first requirements for better health.

Native markets are often dirty and wasteful; food is exposed to sun and flies, infection and disease are spread. Markets properly supervised can be healthy and clean.

Infected meat spreads tapeworm and other diseases. Governments are striving to centralise slaughtering at places where carcases can be inspected and infected ones thrown out.

Fly-blown meat sold at markets and in dirty shops will cause illness. In centres of population, butchers' shops are licensed and inspected for cleanliness.

Death and infant mortality rates are high in the tropics, owing to general ill-health, poor nutrition, tropical diseases, poor sanitation and dirt. Medical, agricultural, and veterinary services are reducing these death rates everywhere, but there is still far to go.

Colonial doctors treat everyone, from primitive tribesmen reached by days of trekking through bush and forest, to city folk who expect the best care modern science can offer. "Bush clinics," run by native assistants, provide rough-and-ready treatment for all in remote places; hospitals with modern equipment serve the big towns.

Empire Lantern Slide Library.—During the six months October 1944 to March 1945 covered by this report, 44,100 lantern slides were issued to schools and lecturers in the United Kingdom. The details are shown below:

	Oct.	Nov.	Dec.	Jan.	Feb.	March.
United Kingdom	240	360	240	240	360	360
Australia	480	360	540	720	420	180
Canada	780	900	840	720	960	540
New Zealand	240	240	120	180	600	480
South Africa	240	300	180	240	240	540
India	720	1,740	480	1,740	2,040	1,260
Burma	120	480	300	360	420	360
The Colonial Empire	2,760	2,760	1,860	3,240	4,680	2,700
Products of the Colonial Empire	420	180	60	60	240	60
General Tours	300	120	120	180	420	420
History	180	120	120	—	240	—
	6,480	7,560	4,860	7,680	10,620	6,900

Miss Cornelia Sorabji, D.C.L. (Oxon.), Barrister-at-Law, Calcutta, has written a general talk on India entitled "All-India Tour." It describes a journey from Bombay through Southern India *via* Hyderabad and Mysore to Madras and Travancore, followed by a second journey through some of the States ruled by Indian Princes beginning with Baroda, through Gwalior, Udaipur, Rajputana, Jodhpur and Jaipur to Bikanir, and finally a third journey through British India from the Sukkur Barrage in Sind up to the North West Frontier, then through the United Provinces, following the River Ganges to Patna, Gaya, Calcutta and Darjeeling, across to Assam and so back to New Delhi and Simla.

Sir Robert Reid, K.C.S.I., K.C.I.E., has supplied the photographs and written a Picture Talk on "Assam." After an outline of the physical geography of the Province, its climate and communications, Sir Robert refers to road building, to the tea industry and to the immigration of Moslems from Bengal who bring with them vigorous methods of cultivation. This is followed by descriptions of the Lushai, Manipuris, Nagas, Abors, Miris and other hill tribes, and an explanation of treaty customs by which peace is maintained on the frontiers. Sir Robert concludes with reflections on how the war in Burma has affected Assam and its future.

Mr. John Goepel, M.A., until recently a Political Officer in Aden, has supplied the pictures and written a talk on the Aden Colony and Protectorate. The introduction tells how Aden ceased to be a home for pirates, and the story goes on to describe its growth to a town of 60,000 inhabitants, in conditions of security, as part of the British Commonwealth. The port, strategically so well placed, is used chiefly by the ships sailing to and from India and the Far East; it also serves the needs of the inland territory of the Aden Protectorate. Mr. Goepel describes the climate of the Protectorate, the Sheikhs and Sultans and the houses, palaces, occupations and religions of the people. He illustrates the building and sailing of dhows, the camel transport system of the interior, and the importance of the few roads in the administration of the country. The Arab gift of ornamentation, and what he can do with mud bricks and plaster in a very dry climate, are shown in the buildings of Seiyun, Shibam and Mukalla. After a description of the street trades of weaver, barber, blacksmith and merchant the talk ends with pictures of tribesmen and Arab children.

Central Film Library.—The demand for films continues to be heavy and the circulation figures for the first four months of 1945 are as follows:

	Empire.	G.P.O.	M.O.I.	Total.
January . . .	3,730	634	9,857	14,221
February . . .	3,128	526	6,425	10,079
March . . .	3,270	550	6,785	10,605
April . . .	2,092	287	4,932	7,311

A grant from the Imperial Relations Trust has enabled the Library to purchase 178 prints of General Empire and Dominion films. Further copies of all the more popular films in these sections were thus made available, including, in the General Empire section, "A Modern Miracle," which deals with modern telecommunications, and in the Australian section "Bushland Revels," dealing with the lyre bird.

The Colonial Empire Marketing Board has provided funds for the purchase of 100 new prints for the Colonial section of the Library. These included further copies of "Song of Ceylon" and four films on East Africa made before the war by Mr. R. Kingston Davies. One of these four films deals with the work of an Agricultural Officer, another with coffee-growing, another with sisal, and the fourth shows the making of a hoe by native craftsmen from the digging of the iron ore through all processes to the finished tool. These films are four of a series, and it is hoped to add more of this series to the Library shortly.

A number of new films dealing with the Empire have been placed in the Library by the Ministry of Information. These include "The Eighth Plague," the story of locust control in East Africa, and "Sisal," and, among other films on India, "Musical Instruments of India," "Melody of Hindustani," "Indian Timber," "Tree of Wealth" (the coconut palm), "Conquest of the Dry Lands" (Punjab), and "Tube Wells" (Ganges plain).

Although the Institute is not open to the public, Empire films have been shown in the Cinema four times a week on an average, to organised parties visiting the Exhibition Galleries. These parties included members of the W.R.N.S. who were undergoing training for overseas service, members of various United Kingdom, Dominion and Allied service units, the Army Basic Educational School, and weekly visits by Indian troops.

Empire Lectures to Schools.—During the first six months of the current lecture season, i.e. from September 1, 1944, to February 28, 1945, 1,767 lectures were delivered to audiences aggregating 250,434 schoolchildren, as against 937 lectures to audiences aggregating 142,576 children during the preceding six months.

The continued growth of the Scheme since its inception has been reported in past issues of this BULLETIN; its undoubted success has been achieved by a combination of wise administration, accurate appreciation of the needs of the schools, and (most important of all) careful choice of really experienced lecturers.

On Saturday, January 13, 1945, the second Conference of Empire Lecturers was held at the Imperial Institute. Under the chairmanship of the Director, sixteen lecturers, many of them nationals of Empire countries, met to discuss "The Technique of Empire Lectures." The Conference was particularly fortunate in having as guests Miss E. M. Verini, M.A., Headmistress of Loughton High School for Girls, Essex; Mr. E. J. Hutchins, M.A., B.Litt., Headmaster of Varndean School, Brighton; and Mr. B. P. Rossi, Headmaster of Arnos Grove Senior (Mixed) School, Southgate, London. Prior to the Conference a paper entitled "Memorandum on the Scope and Treatment of Empire Lectures for the Top Forms of Secondary Schools," prepared by Miss Verini, had been circulated and served as a basis for discussion.

The first part of the Meeting consisted of a brief introduction of their several points of view by each of the three Headteachers who, after paying a high tribute to the benefits which their schools had derived from the Scheme, defined in clear and simple language exactly what schools need to help them in the study of the Empire and its problems. From the fund of their long experience of teaching children (boys and girls of all ages in both secondary and elementary schools) they proceeded to explain how best the common objective might be achieved, offering their observations on the value of personality in the lecturer and on the probable degree of success attained by different methods of approach and technique.

The discussion by the lecturers which followed showed a keen appreciation of the factors involved in talking with success to audiences so diverse in character as those to be found in the great range and variety of grant-aided schools.

The cost of the Scheme is met by grants from interested bodies such as The Leverhulme Trust, the Rhodes Trust and the Imperial

Relations Trust. During the period under review intimations have been received from the High Commissioners for Australia and India that their Governments are prepared to sanction expenditure on lectures arranged by the Imperial Institute on their respective countries.

Empire Schools Correspondence.—During the period covered by this review considerable progress has been made in finding suitable correspondents in England, Scotland, Wales and Northern Ireland for the 2,800 names of students hitherto received from Canada, Southern Rhodesia and almost every country of the Colonial Empire. Up to the time of going to press approximately 2,400 overseas children have been " paired " with children in the United Kingdom. Special care is taken to introduce to each other youthful correspondents of like age, sex, tastes and general interests. Owing to the claims of military service which operate in the United Kingdom and Northern Ireland difficulties have been experienced in making suitable arrangements for overseas students of eighteen years of age and over.

Lists of names of children in South Africa and India are expected at an early date, and it is hoped that Australia and New Zealand will, with the raising of security restrictions, soon be enabled to participate in the Scheme.

Specimens of Economic Products of the Empire.—For many years the Institute has made available to schools for demonstration purposes specimens of raw materials of commerce, of Empire origin, which are not readily available elsewhere. This service is greatly appreciated by Headteachers and during the last six months steps have been taken to replenish stocks which had become depleted during the war years, and to make good deficiencies. Valuable bulk consignments of economic products have already been received from Australia, South Africa and India, and further supplies are expected from other parts of the Empire. In order that these specimens of Empire raw materials may be of greater value for teaching purposes short leaflets are being prepared giving (*a*) a description of each product, (*b*) its principal uses in commerce and industry, (*c*) statistics of total world production (where available) and (*d*) statistics of Empire sources of supply.

Colonial Visitors.—The following is a list of officers on leave from the Colonial Empire who have visited the Institute during the six months ending May 1945:

DECEMBER

M. A. CARDEW, Ceramist, West African Institute of Arts and Industries, Gold Coast.
R. DAY, Education Officer, Nigeria.
J. L. FLETCHER, Controller of Light Industries, Palestine.
A. HOLDEN, Administrative Officer, Nigeria.

C. Q. Y. Hucks, District Officer, Tanganyika Territory.
L. N. H. Larter, Government Botanist, Jamaica.
S. Moody, C.M.G., O.B.E., Colonial Secretary, Mauritius.
J. R. Patterson, C.M.G., Commissioner, Northern Provinces, Nigeria.
R. O. Ramage, C.M.G., Colonial Secretary, Sierra Leone.
C. J. Tyndale-Biscoe, Director of African Education, Northern Rhodesia.

January

T. Barton, Deputy Director of Education, Gold Coast.
C. Bell, Education Officer, Nigeria.
L. Bintley, A.R.I.B.A., Government Architect, Fiji.
H. D. L. Corby, Agricultural Officer, Nigeria.
A. B. Cozens, Education Officer, Nigeria.
J. N. Davies, Education Officer, Tanganyika Territory.
J. W. D. Goodban, Agricultural Officer, Nigeria.
D. B. Jamieson, Agricultural Officer, Nigeria.
T. A. Phillips, Agricultural Officer, Nigeria.
H. H. Spafford, Senior Education Officer, Gold Coast.
Dr. R. E. Vaughan, Department of Education, Mauritius.
H. Vine, Agricultural Chemist, Nigeria.

February

Juma Aley, Education Officer, Zanzibar.
Rev. J. Bardsley, Master, Achimota College, Gold Coast.
R. J. Bee, Public Works Department, Nigeria.
L. R. Doughty, Geneticist, East African Agricultural Research Station, Amani.
R. O. Williams, Deputy Director of Agriculture, Trinidad.

March

N. M. Assheton, Administrative Officer, The Gambia (on deputation to the Gold Coast).
T. F. Betts, Assistant Conservator of Forests, Nigeria.
Rev. E. D. Bowman, M.B.E., Principal, Jeanes Training Centre, Nyasaland.
J. A. N. Burra, Assistant Conservator of Forests, Gold Coast.
M. G. de Courcy-Ireland, Agricultural Officer, Uganda.
Colonel T. T. Gilbert, Principal, Government Technical School, Gold Coast.
G. A. Joy, C.M.G., Civil Secretary, Aden.
R. S. Mackilligin, O.B.E., M.C., Inspector of Mines and Petroleum Technologist, Trinidad.
O. D. Paterson, Inspector of Mines, Nigeria.
Captain F. W. Roe, Geologist, Malayan Geological Service.
W. L. Stapleton, Inspector of Mines, Nigeria.
D. H. Urquhart, Assistant Director of Agriculture, Nigeria.
F. S. Walker, Assistant Conservator of Forests, Kenya.

April

G. K. G. Campbell, Botanist, Nigeria.
G. S. Cansdale, Assistant Conservator of Forests, Gold Coast.
J. A. Fawdry, Inspector of Mines, Northern Rhodesia.
G. F. Hadley, Inspector of Hides and Skins, Veterinary Department, Nigeria.
T. Hirst, Senior Geologist, Gold Coast.
B. C. King, Petrologist, Uganda.
J. W. F. Marriott, Tutor, Makerere College, Uganda.
J. C. K. Marshall, Senior Assistant Conservator of Forests, Federated Malay States.
Captain M. Ogle, Education Officer, Nigeria.
J. H. Palmer, Senior Agricultural Superintendent, The Gambia.
B. T. Steemson, Senior Agricultural Officer, Gold Coast.

May

B. A. Ashley, Chief Inspector of Schools, Kenya.
Captain J. E. P. Booth, Agricultural Officer, Kenya.
J. D. Brown, Senior Agricultural Officer, Nigeria.
C. W. L. Fishlock, Agricultural Officer, Uganda.

DR. D. R. GRANTHAM, Geologist, Tanganyika.
MISS P. B. KNOWLES, Education Officer, Zanzibar.
H. A. LINDEMAN, Education Officer, Tanganyika Territory.
DR. A. E. S. MCINTOSH, Deputy Director of Agriculture, Barbados.
MISS A. NICOL SMITH, Mistress, King's College, Uganda.
W. G. G. PEVIE, Veterinary Officer, Tanganyika Territory.
MISS P. F. RYDER, Assistant Mistress, Government School, Falkland Islands.
C. T. SHAW, Master, Achimota College, Gold Coast.
CAPTAIN C. L. SOUTHALL, Chief Chemist, Malaya.

All Dominion, Indian and Colonial Officers, as well as private residents from the Overseas Empire, who may be visiting London, are cordially invited to come to the Institute to see the Exhibition Galleries and to discuss with the Director and his staff, scientific and technical problems in which they may be interested.

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DIRECTOR'S FOREWORD

WITH the announcement of VE day it was possible to revert to some, at least, of the normal peace-time activities of the Imperial Institute—not to all, for many of the staff are still absent on military duties; but in spite of shortage of staff a certain expansion has been possible. And, of course, VJ day has helped still further.

Our Scientific Departments have been exceptionally busy right through the war. The inquiries put to us, whether involving Laboratory work or not, have never ceased, and, of course, acquired additional importance under war conditions, calling often for accurate information to be furnished at short notice, frequently on the telephone, by our scientific officers. Gaps have occurred in our scientific cadres, in both the Plant and Animal Products and Mineral Resources Departments, owing partly to normal retirements, partly to the permanent seconding of staff to meet Government requirements. Steps are now being actively taken to fill the vacancies with new and fully-qualified personnel. An entirely novel activity is the organisation of lectures to be given in the Cinema Hall of the Institute during this autumn and winter by experts on subjects relating to the development of the mineral resources of the Colonial Empire.

At the time of the reopening of our Exhibition Galleries we were greatly honoured and encouraged by Queen Mary's visit on Monday, July 2. Her Majesty, who was attended by Lady Cynthia Colville and by Major the Honourable John Coke, was welcomed by the Director, accompanied by the General Secretary, the Curator and the Exhibition Officer in charge of the East Gallery. The Director conducted Her Majesty through the Exhibition Galleries. Her Majesty took a deep interest in the various exhibits, particularly those which had been installed during the war in accordance with the latest exhibition technique.

H. A. F. L.

PLANT AND ANIMAL PRODUCTS

A COMPARATIVE STUDY OF SOME PROPERTIES OF KAPOK

By D. A. CLIBBENS,
British Cotton Industry Research Association
Shirley Institute, Manchester.

PRIOR to the war, kapok from Java formed much the greatest proportion of the world's kapok supply. It enjoyed the highest commercial reputation, undoubtedly due in part to a careful control in cultivation, to the use of effective methods for preparation, and to the establishment of a standard system of grading. The complete interruption of the supply from Java during the war, and the greatly increased demand for buoyant and life-saving appliances, resulted in an increased interest in kapok from other sources. In this connection, work has recently been carried out in the laboratories of the British Cotton Industry Research Association at the request of the Ministry of Supply. Of the results obtained in this investigation, some that are of general scientific interest from the point of view of the physical properties of fibres have recently been published by W. R. Rees in a paper entitled " The Overall Specific Volume of Kapok " [1]. The object of the present communication is partly to review the results obtained by Rees, and partly to supplement them with other results of a fundamental nature, including those of buoyancy measurements, which were obtained during the course of the same investigation, and have not been published elsewhere. The buoyancy of kapok is a subject of great practical importance, but it is one that does not appear to have been studied in the most systematic way possible. It will therefore be necessary to consider at greater length than would otherwise be necessary the simple theoretical concepts that must form the basis of buoyancy measurements.

Present knowledge of the fundamental properties of kapok fibres is naturally small compared with the great mass of data available on the properties of the more important textile fibres, but an attempt is here made to provide a broader foundation for future studies of kapok.

1. THE COMMERCIAL USES OF KAPOK

The commercial utilisation of kapok has been developed in three directions, namely (*a*) in the bedding and upholstery industries, (*b*) in the production of buoyant appliances and life-saving equipment, and (*c*) in the construction of thermally insulating and "sound-proof" covers or walls. The particular value of kapok for all these purposes must ultimately be referable to the specific mechanical, physical and chemical properties of the individual fibre, or of the fibres in mass. The properties that are of chief importance depend, however, upon the particular purpose for which the fibre is used, though there is one quality which is of great importance in all the commercial applications of kapok, namely, that in virtue of which a small weight of the fibre occupies an unusually large bulk.

This combination of bulkiness with lightness is an obvious desideratum in a comfortable cushion, a buoyant life-belt, and a warm quilt. The property here concerned is the volume of unit weight, defined as the "overall specific volume" of the fibrous mass, the high magnitude of which is one factor contributing to the value of kapok in all its commercial uses. This is essentially a property of the fibres in bulk, and since a fibrous mass is very compressible, it can only be defined in relation to a specified pressure. Another property of obvious importance is the extent of recovery in volume of the fibrous mass after compression, which may be described qualitatively as its resilience. High overall specific volume and resilience are principal qualities descriptive of a satisfactory filling for bedding or upholstery, but they do not provide a complete description of an efficient filling for buoyant appliances. Qualities are required in a life-belt that are not essential in a cushion.

The manufacture of bedding and upholstery consumed, at least until recently, the greatest proportion of the output of kapok. In commerce, the word "kapok" is therefore sometimes used to denote *any* vegetable fibre that, in virtue of high overall specific volume and resilience, constitutes a reasonably satisfactory filling for upholstery, irrespective of whether or not it possesses the necessary qualities for a buoyant filling. This commercial use, or mis-use, of the word is responsible for much confusion, and necessitates, in any systematic account of the properties of the kapok fibre, a clear definition of the terms used.

2. DEFINITION OF THE WORD "KAPOK"

Kapok properly so-called is the fruit hair of certain species of the genera *Bombax* and *Eriodendron* (alternatively known as *Ceiba*) in the family Bombacaceae. Unlike the cotton hair, kapok is not attached to the seed, but to the inner surface of the seed-pod. The cultivated kapok tree of Java is a species of *Eriodendron* known as *E. anfractuosum*, or alternatively as *Ceiba pentandra* Gärtner. The cultivation of kapok is almost confined to the Dutch East Indies, and to the *Eriodendron* species, though it seems probable that the Ceylon kapok of commerce is of the same species, and that some attention is paid to its cultivation. The Indian kapok of commerce and some African kapoks are, on the other hand, species of the *Bombax* genus, which is native to many parts of the tropics, and is for the most part not grown under cultivated conditions. The term kapok, as used in this paper, is confined to *Eriodendron* or *Bombax* species grown under cultivated or wild conditions.

Vegetable fibres that are sometimes confused in commerce with genuine kapok are the seed hairs of species of the genera *Calotropis* and *Asclepias* in the family Asclepidaceae. They are thus botanically very remote from the genuine kapoks, though they share with them the qualities of high overall specific volume and resilience. The *Calotropis* species of which the seed hair is known commercially as Akund grows wild in parts of the tropics, including India, and unlike Java Kapok (*Eriodendron*) or the genuine Indian Kapok (*Bombax*), it is almost valueless as a buoyant filling. Akund is sometimes encountered under the misleading name of " Brazilian Kapok."

Milkweed floss is the seed hair of an *Asclepias* species, known as *A. syriaca*, that grows wild in North America, and that has only been utilised commercially during the war. It has much greater value as a buoyant filling than the botanically closely related Akund, and in this particular respect it resembles the botanically remote kapoks of the Bombacaceae family.

3. SIMPLE GEOMETRICAL CHARACTERS OF KAPOK COMPARED WITH THOSE OF OTHER FIBRES

When examined under the microscope, the kapok fibre is seen to consist of a smooth-walled tube, nearly circular in cross-section, and with walls very thin in relation to the diameter of the fibre. In these respects kapok fibres closely resemble the seed hairs of the Asclepidaceae, Akund and Milkweed floss. They differ from the mature cotton hair, which is characterised by relatively thick walls, and by the collapse of the originally tubular structure to a flatter and convoluted form when the hair is removed from the seed and allowed to dry.

The mean length of the kapok fibre is in the range, ¾ to 1 in., though samples that have been machine-processed are generally shorter (down to ⅝ in.), presumably owing to the breakage of fibres. Milkweed floss is very similar in staple length to kapok, but Akund is longer (1¼ to 1½ in.). The width (diameter) of kapok is in the neighbourhood of 20×10^{-4} cm., being very similar to that of Milkweed floss, but less than that of Akund.

One of the most useful measurable characteristics of fibres is their mean weight per unit length (abbreviated to " fibre-weight "), which can be determined with considerable accuracy by methods that were originally elaborated for the study of the cotton fibre [2]. Table I gives measurements of fibre-weight expressed in units of 10^{-8} gram per cm., and it compares the values obtained for various kapoks with those given by Akund, Milkweed floss and representative cottons.

TABLE I

Fibre.	Fibre Weight per Unit Length. 10^{-8} gram/cm.
Kapok from:	
Java (Prime)*	81
Ceylon	72
Nigeria	63
West Africa	67
Tanganyika	80
Akund from Brazil	104
Milkweed floss from U.S.A.	84
Cotton:	
Native Indian	ca. 220 to 300
Texas	ca. 190 to 220
Egyptian	ca. 130 to 190
Sea Island	ca. 120

* *The grade of Java Kapok used throughout the investigation was that known as Prime Java, which is the grade generally specified for live-saving appliances. The grade of Java Kapok is partly determined by its cleanliness, and is thus influenced by the hand-cleaning or machine-processing of the crop subsequent to gathering. It is no doubt also determined partly by other considerations such as maturity of the crop, and its freedom from damage by weather, pests, etc.*

The table shows that all samples of kapok, as well as Akund and Milkweed floss, have lower fibre-weights than even the finest cotton (Sea Island), and much lower than ordinary American cotton (Texas). This is a consequence, not of a smaller fibre diameter, but of the relative thinness of the cell walls. Immature, or "unripe," cotton hairs, gathered before the so-called " secondary thickening " of the walls is complete, may possess fibre-weights as low as, or lower than, those of the mature kapoks. The maturity of the fibre may clearly affect the fibre-weight of kapok, and in this respect the controlled and cultivated crop from Java is likely to provide the most reliable standard. Measurements have been made on a number of different samples of Prime Java Kapok, and all have yielded values for the fibre-weight in the neighbourhood of 80×10^{-8} gram/cm. Some of the African Kapoks examined are likely to be *Bombax*, as distinct from *Eriodendron*, species, and there is no evidence in this work to suggest that the two different kapok species could be distinguished by any measurable character of the individual fibre, or by any examination under the microscope. A wider range of more precisely described samples would be necessary before a positive assertion to this effect could be made.

If, as a near approximation, the kapok fibre is assumed to be a perfect cylinder of diameter 20×10^{-4} cm., and fibre-weight 80×10^{-8} gram/cm., the volume occupied by unit weight of the fibre can easily be calculated, and is 3·9 c.c./gram. This is the specific volume of the *individual fibre*. In any assemblage of kapok fibres the " overall " specific volume must be higher, because it is impossible to pack cylindrical fibres so that there is no free space between them. It can be calculated that under the conditions of closest packing—like cigarettes in a box—the overall specific volume of kapok would be 4·3 c.c./gram. This is the lowest specific volume at which kapok could be packed without distorting (flattening) the circular cross-section of the fibre. Its inverse—0·23 gram/c.c., or 14·5 lb./cu. ft.—is the highest density of packing consonant with the preservation of the cylindrical form. It must be concluded that in any kapok package compressed to a density exceeding 14·5 lb./cu. ft. the individual fibres are flattened to a greater or less extent in the way that a rubber tube is flattened when squeezed between the fingers. Since " conditions of closest packing " are certainly not realised in any actual fibre package, some degree of flattening of the kapok fibre must occur in packages of density considerably below 14·5 lb./cu. ft.

4. THE RIGIDITY OF KAPOK, COMPARED WITH THAT OF SOME OTHER FIBRES.

In geometrical form, the immature cotton fibre devoid of secondary thickening is not unlike the kapok fibre in so far as it consists of a thin-walled approximately cylindrical tube. Yet as soon as it is separated from the seed, and dries in the air, it collapses to an exceedingly thin flat ribbon of low rigidity, which easily entwines itself with other neighbouring immature fibres into small inextricable fibre-knots that greatly lower the value of the cotton for textile purposes. The collapse of the tubular structure is, of course, also a characteristic of the mature, fully thickened, cotton fibre, and then leads to a bean-shaped cross-section, instead of a ribbon. Kapok fibres do not of themselves collapse when removed from the pod and allowed to dry; indeed, it will be shown later that if they are made to collapse by the application of mechanical pressure, they will under certain conditions spontaneously recover their cylindrical form. Whatever may be its fundamental explanation, this is a very striking difference between the kapok and the cotton fibre.

During the course of investigations on cotton, a method has been elaborated by means of which the torsional rigidity of single fibres can be readily measured at a constant humidity of the atmosphere. [3] In this method, the fibre is used as the suspension for a miniature torsion pendulum, which is made to oscillate, and the torsional rigidity of the fibre is calculated from the observed period of oscillation. The rigidity of a cotton, or of a kapok, fibre naturally depends upon the amount of material in its cross-section, being greater for a relatively coarse, than for a relatively fine, fibre. Since there is a great variability in this respect between the individual fibres of any one kind, there must be a corresponding variability in fibre rigidity. The wall-thickness and cross-sectional area, although themselves not accurately measurable, are evidently closely correlated with the fibre-weight, the relatively coarse hairs being characterised by relatively high fibre-weights. The rigidity of a fibre is also determined by the geometrical shape of, as distinct from the amount of material in, its cross-section. In this respect there is little intrinsic difference between the kapoks, Akund, and Milkweed floss (see, however, Sections 7 and 8), but the form of the cross-section of the cotton hair is very different from these owing to the collapse of the fibre, and is much more variable. Finally, the rigidity of a vegetable fibre may be affected by the humidity of the atmosphere with which it is in equilibrium. Since the measurement of torsional rigidity is not a destructive one, it can be made on the same individual fibre at different humidities, and the effect of humidity on rigidity can therefore be determined without taking statistical account of the variability in the dimensions of fibres composing any one kind.

Table II contains measurements of the torsional rigidity of different vegetable fibres at relative humidities of 65 per cent. and 87 per cent. The figures were obtained from the means of observations on five fibres of each kind. In view of the variability between fibres of any one kind, this is not generally sufficient to yield reliable mean values, but the fibre-weights were also measured, and are recorded in the table, for the actual fibres used in the measurement of rigidity. These fibre-weights, although differing somewhat from the true mean values (as given in Table I, which refers to the same materials), show that the sample of five fibres is reasonably representative of its kind in the important respect of cross-sectional area.

TABLE II

Fibre.	Fibre-Weight. 10^{-8} gram/cm.	Torsional Rigidity dyne cm.^{2}	
		at 65% R.H.	at 87% R.H.
Kapok from:			
Java (Prime)	72	0·0424	0·0484
Nigeria . . .	69	0·0410	0·0448
Akund from Brazil .	120	0·149	0·217
Milkweed floss from U.S.A.	98	0·159	0·151
Texas Cotton . .	198	0·0296	0·0203

The results show striking differences between the rigidities at a constant humidity of the kapoks, the fibres of the Asclepidaceae (Akund, Milkweed floss), and cotton. Although the cotton fibre contains a much greater mass in its cross-section, as shown by its much higher fibre-weight, it yet possesses a much lower rigidity than the kapok fibre. Akund and Milkweed floss on the other hand, with somewhat greater fibre-weights than the kapoks, possess much greater rigidity.

A rise in relative humidity from 65 per cent. to 87 per cent., whilst it is accompanied by a rise—or at least little change—in the rigidity of the kapoks, Akund, and Milkweed floss, is accompanied by a considerable fall in the rigidity of cotton. The effect of humidity on rigidity will be referred to again in Section 8.

5. CHEMICAL PROPERTIES OF KAPOK.

Much remains to be learnt about the chemistry of kapok, and little fresh can be added here. Cotton approximates to pure cellulose, being built up almost entirely from the hexose sugar, glucose. Kapok is known as a so-called " compound cellulose " which contains, or from which can be formed, pentose sugars. The proximate method of analysis known as the determination of pentosans shows that kapok contains in the neighbourhood of 30 per cent. of pentose sugars combined in a carbohydrate complex, or of substances which yield an equivalent weight of pentose sugars in the analysis ; the same is true of Akund.

Characteristic of cotton and other " pure cellulose " fibres are their initial swelling, and ultimate dissolution, in cuprammonium hydroxide solution. There is little swelling, and no dissolution, of kapok or of the Asclepidaceae fibres in cuprammonium. Another characteristic of cotton is its stability towards hot, dilute, caustic alkalies ; a usual technical treatment preparatory to the bleaching or dyeing of cotton textiles consists of boiling them with caustic soda solutions of concentrations up to 2 per cent. at pressures up to 40 lb./sq in. in excess of atmospheric. Treatments of this kind have a profound effect on kapok. In the first place, such treatment renders the kapok completely soluble in cuprammonium, viscous solutions being obtained comparable in viscosity with those formed by bleached cotton at similar concentrations. Visually more striking is the complete collapse of the kapok fibre under the treatment, and its consequences. When examined under the microscope, the originally tubular fibre is seen to have collapsed to a flat, ribbon-like form deceptively similar to that of immature cotton. The low rigidity of the treated fibres causes them to entwine with one another in the form of a relatively dense fibre mat that can be moulded when wet, and on drying retains its form, and has a consistency not unlike that of thick cardboard. Thus the boiling of kapok with dilute caustic soda under pressure results in the loss of its most valued quality, namely, its great voluminosity. This is certainly a consequence of the loss in fibre rigidity following the collapse, and the behaviour of the treated material towards cuprammonium suggests that the collapse may be associated with the conversion of a " compound cellulose " into something approaching the " pure cellulose " of the cotton fibre.

Most samples of both cotton and kapok contain 2 per cent. to 3 per cent. of material soluble in cold water, and both contain similar amounts—in the neighbourhood of 1 per cent.—of fat and wax extractable with an organic solvent such as chloroform. The water-soluble extractives are partly inorganic, partly organic—the latter possibly consisting of soluble carbohydrate precursors in the plant synthesis of cellulose. In the case of cotton, at least, the water-soluble extractives provide nutrient material for the growth of micro-organisms, the liability of cotton to attack by such organisms being reduced by washing with water. As will be seen later in another connection, kapok is also able to support the growth of micro-organisms under favourable conditions of temperature and humidity, and there is no evidence of any pronounced difference in this respect between cotton and kapok, just as there is little difference in the amount of their water-soluble extractives. When kept at 25° C. in an atmosphere saturated with water vapour, Akund is far more tolerant of micro-biological growths than cotton or kapok as judged by the powerful and extremely unpleasant smell that it quickly develops under these conditions. It may be significant in this connection that a sample of Akund yielded the remarkably high value of 12 per cent. for its water-soluble extractives. Under the favourable conditions of humidity and temperature mentioned above, Milkweed floss develops a yellow tint and acquires a slimy surface within a few days, evidence of micro-biological growth not observed with kapok or cotton. The sample examined contained 4·5 per cent. of material soluble in cold water.

6. The Overall Specific Volume of Kapok and of other Fibres.

As already explained, overall specific volume is a property of direct importance in all practical applications of kapok as a filling material; it is the quantitative definition of filling capacity. The experimental determination of specific volume is superficially very simple since it consists in measuring the volume of a known weight of the fibrous mass. The measurement of volume must evidently be made under a constant pressure, the specific volume must be associated with a known pressure, and it will decrease as the pressure rises. The volume of a fibrous mass, even at a constant pressure, is not however so well-defined a quantity as the volume of a homogeneous body, and the technique of measurement must embody special features if the results are to be usefully interpreted. Details of the technique worked out for the purpose are described in Rees' account of his work. [1]

The units used for specific volume may be alternatively cubic centimetres per gram or cubic feet per pound, and in this paper the former will generally be used since they possess certain practical advantages. The inverse of overall specific volume is the more familiar quantity known as the density of packing, which may be expressed in grams per cubic centimetre, or in pounds per cubic foot.

Table III gives the specific volumes measured under 1.0 lb./sq. in. pressure of different commercial fibres as determined on samples chosen at random, and without reference to their histories. A pressure of 1·0 lb./sq. in. is of the order of that normally applied by hand in the fairly compact filling of covers with fibre.

Table III

Fibre.	Specific Volume, c.c./gram (1.0 lb./sq. in. pressure).
Indian Cotton	8·4
Prime Java Kapok	13·7
Akund	15·8
Ceylon Kapok	20·4
Milkweed Floss	22·3

The fibres listed in the table show a nearly threefold range in the volume occupied by the same weight at the same pressure. The Ceylon Kapok has a much greater filling capacity than the Prime Java Kapok, and practical experience confirmed this difference. Thus, the standard lifejacket [4] consists of a fabric cover of specified dimensions filled with a specified weight of Prime Java Kapok, and when the attempt was made to replace this by Ceylon Kapok the specification was not easily satisfied because of the great difficulty of inserting the requisite weight of Ceylon Kapok into the standard cover. In the same way the large recorded difference in specific volume between Milkweed floss and Prime Java Kapok was confirmed as soon as the attempt was made to insert into a standard lifejacket cover a weight of Milkweed floss equal to the customary weight of Prime Java Kapok.

7. THE EFFECT OF PRESSURE HISTORY ON OVERALL SPECIFIC VOLUME.

A closer investigation of these results showed, however, that they only partially represented intrinsic differences between the different kinds of fibres, and that they strongly reflected differences of a more accidental nature in the history of the materials prior to the measurement. The specific volume of the hollow fibres was shown to be greatly affected by the pressures to which the fibre packages had been submitted. This was not due to the formation of dense lumps or fibre aggregates by the action of the pressure, since the technique of the measurement prescribes that the samples shall be carefully "opened," or teased out, by hand before the measurement is made; since the size of sample employed is only small, this can be done very effectively. It has been shown conclusively by Rees [1] that the effect of the pressure history on the specific volume of kapok is due to a flattening under sufficiently high pressure of the originally cylindrical fibre, *and its failure to recover completely when the pressure is removed, and the fibre mass opened out by hand.* It has already been deduced in Section 3 that some flattening of the kapok fibre must occur in packages compressed to a density of 14·5 lb./cu. ft., and probably at considerably lower densities. The new fact to be revealed is that the fibres fail to recover their original form when the pressure is removed and the material allowed to stand for very long periods under ordinary conditions. On this account they may show specific volumes much below the maximum and the actual values obtained may be very greatly affected by the precise pressure conditions to which they have been subjected during their earlier history. This is equally true of Java Kapok, Ceylon Kapok, Milkweed floss, and presumably of other hollow fibres.

The important effect of pressure history on the specific volume of Ceylon Kapok and of Milkweed floss is shown in Table IV. In order to obtain the figures recorded in this table different samples taken from the same bulk were compressed under increasingly high pressures. They were kept under the pressure usually for a day, and were then released and allowed to recover as far as they would by standing unconstrained, again usually for a day, under the existing atmospheric conditions. The results were very little affected when the duration of the pressure application, and that of the recovery period, were greatly prolonged beyond one day. The actual pressures to which the samples were subjected were not measured, but only the densities of the compressed packages, which are naturally higher the higher the packing pressure. Thus, the first column, which gives the packing density, reflects a steady variation in pressure history. The specific volumes were all measured under a constant pressure of 1.0 lb./sq. in. on samples that, whatever their history, had been effectively opened out by hand before the measurement.

TABLE IV

Packing Density. lb /cu.ft.	Specific Volume, c c /gram at 1·0 lb /sq. in.	
	Ceylon Kapok.	Milkweed Floss.
Not Compressed	20·4	22·3
3·1	—	20·6
3·9	19·0	—
10·0	—	19·7
10·8	17·6	—
16·0	—	18·9
16·4	16·4	—
27·4	13·2	—
28·8	—	14·7
57·7	—	11·1
68·0	9·8	—
84·0	8·6	6·9
94·0	7·6	—

The table shows the steady fall in the specific volume of both fibres that accompanies a rise in pressure during the history of their pre-treatment. The initial values of specific volume—for samples described as "not compressed"—were obtained on the materials not deliberately compressed as a part of the experiment. Since they were commercial materials their pressure histories were not precisely known, and to this extent the initial values of specific volume have a certain arbitrary character. It is clear that the specific volume of an arbitrary sample of unknown history cannot in general be a characteristic of the kind of fibre. For example, although the results given for commercial samples in Table III show the Ceylon Kapok and Milkweed floss to have much greater filling capacity than Prime Java Kapok, Table IV shows that the same materials submitted to other mechanical treatments during their commercial handling might have yielded the opposite result.

The reason for the variable pressure history of commercial kapok and other fibre fillings is that they are often compressed into bales for convenience of transport overseas to the factory where they are to be used. The pressures employed in baling are almost certainly both variable and indeterminate. In the laboratory compression of the samples to which Table IV refers the pressure was increased steadily up to its maximum value, and it is only under these conditions that the density of the package gives an adequate, if arbitrary, indication of the pressure history. In commercial baling it seems likely that the pressure may transitorily far exceed that which corresponds to the final density of the bale, which is then valueless as an indication of pressure history.

In order to obtain a uniform product, and the best commercial results, kapok must be freed from seed, plant debris, and other extraneous impurities (" cleaned "), and the individual fibres in any denser aggregates must be separated from one another (" opened "). The first stages of the cleaning and opening process are hand operations, but the final stages consist of a machine treatment of a willowing nature. With Prime Java Kapok, the whole process is carried out at or near the plantation, the fibre is finally baled, and transported to the factory in a condition suitable for use on withdrawal from the bale. With kapok from other sources, for example, Ceylon or Tanganyika, opening and cleaning machinery has not generally been available in the producing country. Such kapoks are baled either in the raw or hand-cleaned condition, and transported to this country, where they may be used directly in the hand-cleaned condition without further processing. The Ceylon Kapok forming the subject of this investigation was, however, machine-processed in this country after removal from the bale, and it was not then baled, or otherwise subjected to high pressure, after its final opening, but was employed on the spot for the manufacture of buoyant or other appliances. This apparently small difference--between baling before and after the final machine-process—is precisely the kind of difference in pressure history that must be expected to influence specific volume. So long as this difference in commercial practice exists, Prime Java Kapok is likely to have a lower filling capacity than other sorts machine-processed in this country. The sample of Milkweed floss examined was one of only a few pounds in weight that had not been compressed for transport from America, and had probably never been subjected to any great pressure.

8. THE EFFECT OF HUMIDITY AND TEMPERATURE HISTORY ON OVERALL SPECIFIC VOLUME.

All the recorded measurements of specific volume were made on samples in equilibrium with air at 65 per cent. relative humidity. If samples of kapok or Milkweed floss that have been subjected to high pressure are first brought into equilibrium with air at 100 per cent. relative humidity, and are then " re-conditioned " at 65 per cent. relative humidity before the measurement is made, they experience a rise in specific volume. This is due to a recovery from the effects of pressures imposed during the history of the samples, effects that are irreversible, or only very slowly reversible, at ordinary humidities. A similar, though slightly less complete, recovery occurs when the samples are exposed to high humidities somewhat short of saturation, for example, 90 per cent. relative humidity. A smaller recovery of volume occurs when the samples are oven-dried, and the recovery is most complete if the materials are submitted to cyclic changes including humidification and oven-drying. A number of measurements were made by Rees [1] in the following way: The specific volume of the sample was first measured at 65 per cent. relative humidity and 18° C. It was then stored for a few hours over water, dried in an oven at 100° C., re-conditioned at 65 per cent. relative humidity and 18° C., and its specific volume again measured under these conditions. For convenience, this treatment will be called the cyclic humidity/temperature treatment. The experimental samples described in Table IV, that had been subjected to very high pressures, and consequently possessed relatively low specific volumes, showed the effect of this treatment in striking fashion, as may be seen from Table V.

TABLE V

Treatment.	Specific Volume, c.c./gram, under 1.0 lb/sq. in. and 65 per cent. R.H. Ceylon Kapok.	Milkweed Floss.
1. None (Commercial Materials) . .	20·4	22·3
2. Highly compressed, then allowed to recover for one day at 65 per cent. R.H.	8·6	11·1
3. As 2, but allowed to recover for seven days at 65 per cent. R.H. . .	9·3	11·3
4. As 2, then submitted to the cyclic humidity/temperature treatment . .	22·4	24·8

The table shows that the recovery in volume after release from the high pressure is exceedingly slow under the normal conditions of storage at 65 per cent. relative humidity, but that the cyclic humidity/temperature treatment brings about an increase in volume to a value even greater than that of the materials before they were submitted to the high pressure.

The experimentally applied pressures that resulted in packing densities in the range of 60 to 90 lb./cu. ft. would certainly be abnormally high for any commercial treatment of kapok. Bales of Prime Java Kapok imported into this country are packed at a density of 10 to 15 lb./cu. ft., though it has already been pointed out that this offers no very reliable indication of the pressure history of the material, since the pressure during baling may transitorily rise to high values. Commercial samples of Prime Java Kapok, of Ceylon Kapok, and of Milkweed floss, were submitted to the cyclic humidity/temperature treatment, and their specific volumes were measured before and after it with results shown in Table VI.

TABLE VI

Commercial Fibre	Specific Volume, c.c./gram, at 1·0 lb./sq. in. and 65 per cent. R.H.	
	Before Treatment	After Treatment.
Prime Java Kapok	13·7	26·3
Ceylon Kapok	20·4	26·2
Milkweed Floss	22·3	24·8

From the values obtained after the treatment, it can be seen that there is little real difference between the filling capacities of the three fibres. The difference recorded for the materials before treatment are to a large extent due to their different pressure histories. It will be noted that the specific volume of the two kapoks after the treatment are virtually identical and somewhat higher than the value given by the highly compressed Ceylon Kapok in Table V after the cyclic humidity/temperature treatment. The volume recovery was presumably not quite complete after the very high compression.

Photomicrographs and camera lucida drawings reproduced in Rees' paper [1] provide final proof of the fact that the influence exerted on the overall specific volume of kapok by its pressure, humidity and temperature history is due to changes in the shape of the cross-section of the fibre as described above. For the purpose of obtaining such evidence, the fibres must be mounted in non-aqueous media since immersion in an aqueous medium results in a recovery of form similar to that which occurs on exposure to an atmosphere saturated with water vapour.

The effect of humidity on the torsional rigidity of the hollow fibres illustrated in Table II also probably reflects to some extent the accidents of their early pressure history. For a fibre that has been flattened by pressure, a rise in humidity tends to restore the circular cross-section, and this must result in an increased rigidity.

9. ELEMENTARY CONSIDERATION OF BUOYANCY, AND THE TERMS USED IN DESCRIBING IT. SPECIFIC BUOYANCY.

If a body of weight W in air is first held totally submerged in water and then released, it may either sink to the bottom or rise to the surface. In the former case it is called a sinker, and it has a positive weight w in water, which is, however, less than its weight W in air. In the latter case the body is called a float; its weight in water is negative, and may be denoted by - w. A clearer physical picture is obtained if the float is regarded as having a *positive upward thrust* T in water, equal in magnitude to its negative weight but opposite in sign:

$$T = -w$$

If a sinker is attached to a float not sufficiently buoyant to support it, the weight of the combination in water is less than that of the sinker alone. The float can be regarded as exerting an upward thrust on the sinker that reduces its weight. If w_s is the weight of the sinker alone in water, and w_c the weight of the combined sinker and float, w_c is less than w_s and the difference $w_s - w_c$ is clearly equal to the upward thrust of the float:

$$T = w_s - w_c \quad \ldots\ldots\ldots\ldots\ldots\ldots 1.$$

The upward thrust is the most important practical characteristic of a float. If the weight of a sinker in water is exactly equal to the upward thrust of a float, the combination of the two will hover in water, neither sinking nor rising, when released. The weight of the combination in water w_c is then zero, and from equation 1, T is therefore equal to w_s. In other words, the upward thrust of a float is the weight in water of the heaviest sinker that it will just support.

The above considerations clearly indicate the method for determining the upward thrust of any float. A sufficiently heavy sinker is weighed in water. The float is then attached to it, and the combination is weighed in water. The reduction in weight of the sinker caused by the attachment of the float to it is the upward thrust of the float.

The relation between the weight of a body in air and that in water is expressed by the law of Archimedes, which is valid whether the weight in water is positive (sinker) or negative (float). According to this law, the difference between the weight of a body in air W and its weight in water w is equal to the weight of the volume of water displaced by the body, or to the volume of water displaced V multiplied by the density of water ρ:

$$W - w = \rho V$$

For a float, where the upward thrust T is equal to $-$ w:

$$W + T = \rho V$$

Since the density of water at the ordinary temperature is very near to unity in the c.g.s. system of units, the factor ρ can be omitted, and the equation written:

$$W + T \text{ (grams)} = V \text{ (c.c.)}$$

In the future use of this equation, the units will be omitted, but it must be remembered that, in this form, the equation is only valid for weights and upward thrusts expressed in grams, and volumes in c.c.

The equation can obviously be written:

$$\frac{T}{W} = \frac{V}{W} - 1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.$$

and its application to a buoyant fibrous mass, such as a kapok lifejacket, will be considered.

The quantity T/W is the upward thrust per unit weight of the fibre filling (the weight of the fabric cover is neglected). This quantity will be called the *specific buoyancy* of the fibrous mass, denoted by b:

$$b = T/W \text{ or } T = bW \quad \ldots\ldots\ldots\ldots\ldots\ldots 3.$$

Provided that upward thrusts and weights are measured in the same units, the specific buoyancy is obtained by dividing the former by the latter irrespective of whether those units are grams or pounds. Equation 2 can thus be written:

$$b = \frac{V}{W} - 1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 4.$$

As an illustration of the use of specific buoyancy, the standard kapok-filled lifejacket contains 1½ lb. of kapok, and has a specific buoyancy of about 15½. From equation 3 its upward thrust, or supporting force, is therefore about 23 lb. The specific buoyancy of ordinary wood is about unity, so that its upward thrust is about equal to its own weight in air.[1]

The quantity V/W in equations 2 and 4 is the ratio of the volume of water displaced by the body to its weight in air, measured in c.c. per gram. If there is no penetration of water into the fibrous mass, the volume of water displaced by it is clearly equal to its own overall volume, and the quantity V/W is then equal to its overall specific volume v, measured in c.c. per gram. For this particular case, equation 4 reduces to the simple expression:

$$b = v - 1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 5.$$

Thus, when there is no penetration of water into the float, its specific buoyancy is simply its overall specific volume (c.c./gram) diminished by unity.

The condition that penetration by liquid water shall be very slow is an essential requirement for an efficient float; it is true for wood, cork, kapok masses, and inflated rubber belts or wings. In the standard kapok-filled lifejacket the kapok is packed at a density of about 3¾ lb./cu. ft., and this is nearly the highest practicable hand-packing density for Prime Java Kapok. It corresponds to an overall specific volume of about 16½ c.c./gram. The fact that the specific buoyancy of the jacket is in fact close to 15½ shows that equation 5 is approximately valid, and that there is little penetration of water into the fibrous mass.

10. THE DISPLACEMENT OF AIR FROM FIBROUS MASSES BY WATER. DISPLACEMENT PRESSURE AND DEGREE OF WATER-LOGGING.

It is seen from equation 4 that the specific buoyancy can only possess a positive value when V/W is greater than unity. Now V, the volume of water displaced by the body, has its maximum value when there is no penetration of water, and the maximum possible value of V/W is therefore equal to the overall specific volume. Hence a necessary, but not sufficient, condition for positive specific buoyancy is that the overall specific volume shall be greater than unity. It has been seen that for hand-packed kapok masses, the overall specific volume may be in the neighbourhood of 16 c.c./gram or higher, and thus much greater than unity. It has also been seen in Section 3 that the overall specific volume of an individual kapok fibre is in the neighbourhood of 4, also higher than unity. But the specific volume of the substance forming the walls of the kapok fibre is only about 0·7—less than unity. The fibre substance thus has a negative specific buoyancy—it is a sinker and not a float. The high specific volumes of the fibrous mass, and of the individual fibre, are of course due to the entrainment by them of relatively large volumes of air, which itself has a specific volume of about 800. In the individual fibre, the air is contained within the hollow tube, and in a mass of kapok fibres a still greater volume of air is entrained between the individual fibres. Some writers have believed that the air within the individual kapok fibres is chiefly responsible for the buoyancy of a kapok float, but this is clearly untrue. The specific buoyancy of buoyant kapok equipment is commonly 15 or more, of which that contributed by the sum of the individual air-filled fibres cannot exceed 3 (one less than the overall specific volume of the individual fibre).

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[1] In the technical literature the word "buoyancy," when used in a quantitative sense, may have any one of at least three different meanings, namely, upward thrust, upward thrust per unit weight (specific buoyancy as defined above), or upward thrust per unit volume (specific buoyancy multiplied by overall density, usually in pounds per cubic foot).

Suppose that, in Fig 1, ABCD is a cover perfectly permeable to water, containing a buoyant fibrous filling. The float is totally submerged by means of a sinker S, beneath the water surface FG, and no water is supposed to penetrate into it. At the highest level AB on the submerged float the air entrained by the filling is subject to a hydrostatic pressure equal to the head of water d_1. At the lowest level CD the air is subject to the greater hydrostatic pressure d_2. This pressure difference necessarily tends to cause replacement

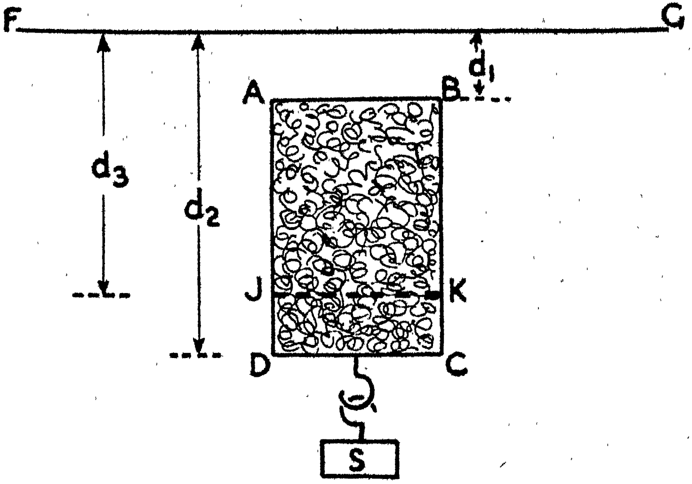

FIG. 1

of the air by water, the air being released at the top of the float and water entering at the bottom. If such replacement occurs, the volume of water displaced by the float diminishes, and its specific buoyancy diminishes in accordance with equation 4; the float is said to become waterlogged to a greater extent as the replacement of air by water progresses. Other things being the same, the tendency of the float to become water-logged must increase as the pressure difference represented by the head of water d_2 d_1 increases. This head will be called the *displacement pressure*, and for shallow submersions it is virtually independent of the depth of submersion.[1] When there is no water-logging, it is given by the difference between the highest and lowest levels on the float, and thus depends only on the shape and dimensions of the float, and the weight distribution of the sinker—which determines the orientation of the float in the water. When water-logging begins the level of water rises inside the float above the level CD, and the displacement pressure is no longer equal to $d_2 - d_1$, but to some such value as $d_3 - d_1$, where JK is the level to which the water has risen. Thus, as water-logging progresses the displacement pressure falls; on these grounds, the rate of water-logging would therefore be expected to be greatest on first submersion, and to diminish with time.

The fact that some fibrous masses may be submerged in water for long periods without appreciable water-logging implies the existence of a pressure that opposes the displacement pressure, and thus stabilizes the air system within the float. This opposing pressure is a result of the surface tension of the water. It is not proposed to elaborate the theory of the pressure differences across water-air surfaces, but it can be shown that if the fibrous mass is regarded as a system of fine capillary spaces, or as presenting a fine-mesh network surface, such differences, opposing in direction the displacement pressure, are set up when the surfaces of the fibres are not wetted, or are only imperfectly wetted by water. The surface tension pressure is determined by the surface tension of the water, the nature of the fibre surfaces, and the size of the capillary spaces, or of the surface mesh, in the fibrous mass. For a given fibre packed to a given density, and submerged in water, there must be a certain maximum surface tension pressure available to oppose the displacement pressure. On the other hand, the displacement pressure can be increased indefinitely, simply by increasing the height of the submerged fibre column. Thus, fibre floats with displacement pressures beyond a certain maximum value, depending on the nature of the fibre filling, must always water-log rapidly, and the water-logging will continue until the rise in water level within the float has reduced the displacement pressure to a value that can be counterbalanced by the surface tension pressure.

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[1] The effect of the total hydrostatic pressure on the volume of the air within the float is neglected in this and the subsequent discussion.

Even at relatively low displacement pressures, all fibrous masses submerged in water gradually become water-logged, though for efficient floats, such as those with kapok fillings, the process is a very slow one. This spontaneous water-logging is presumably due to a gradual change in the conditions at the surface of the fibres, as a result of which they become more readily wetted by water. As a consequence of such changes the rate of water-logging over long periods of submersion generally increases with time. It is convenient to be able to express the degree of water-logging of a float in quantitative terms. A satisfactory theoretical definition of the degree of water-logging is the ratio, expressed as a percentage, of the volume of air expelled from the float (and replaced by water) to the volume of air originally contained by it before immersion in water. In this sense, the degree of water-logging may vary from zero for a float in its most efficient condition to 100 per cent. for a float that is completely water-logged.

The degree of water-logging ℓ so defined can be calculated from the specific buoyancy of the float, its overall specific volume and the specific volume of the fibre substance. It is given by the equation:

$$\ell = 100\,\frac{v - (1 + b)}{v - v_T} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 6.$$

where b is the specific buoyancy, v the overall specific volume, and v_T the true specific volume of the fibre substance. A sufficiently accurate value can however be calculated in the following simpler way, provided that the water-logging is not too rapid or too far advanced. The upward thrust of the float is determined immediately after immersion, and it is assumed that no water-logging occurs in the short time necessary for this measurement, so that the corresponding initial specific buoyancy b_0 is given by equation 5, and v is thus equal to $1 + b_0$. If at any later time t, when water-logging has become appreciable, the measured specific buoyancy is b, the degree of water-logging as given by equation 6 is:

$$\ell = 100\,\frac{(1 + b_0) - (1 + b)}{(1 + b_0) - v_T} = 100\,\frac{b_0 - b}{b_0 + (1 - v_T)}$$

Now the true specific volumes of all vegetable fibre substances are sufficiently near to unity to permit the term $(1 - v_T)$ being neglected in relation to b_0, without any considerable error. The degree of water-logging is then simply the fall in specific buoyancy $(b_0 - b)$ expressed as a percentage of the initial value b_0, or the fall in upward thrust of the float expressed as a percentage of its initial upward thrust. This simple method for calculating degree of water-logging has generally been used, and nearly satisfies the definition given above when water-logging is relatively slow. If T_0 is the upward thrust of the float on first submersion, and T its upward thrust after submersion for the time t, the degree of water-logging at the time t is calculated from :

$$\ell = 100 \quad \frac{T_0 - T}{T_0}$$

The rate of water-logging is described by the variation of ℓ with t.

11. Experimental Description and Measurement of Buoyancy.

The buoyancy of a fibrous mass can be described quantitatively by (*a*) its initial specific buoyancy in water, and (*b*) its rate of water-logging, or its rate of change of specific buoyancy with time under defined conditions.

The initial specific buoyancy, which is the buoyancy when no water-logging has occurred, can be calculated from the overall specific volume by equation 5, or it can be determined experimentally when the water-logging is sufficiently slow to be negligible in relation to the time required to make the initial observation of upward thrust.

In practice, most buoyant equipment, such as lifejackets or buoyant tanks, are filled by hand as tightly as reasonably practicable. In an extremely rough way, this means that they are filled at a constant pressure. The comparison of different fibres in respect to initial specific buoyancy should therefore be made for fibre masses packed under a constant pressure. Table III in Section 6 contains measurements of overall specific volume at 1.0 lb./sq. in. pressure, made on various commercial fibres. This pressure is of the order of the average pressure applied in the hand-packing of buoyant equipment. The table shows, for example, that the specific volume of cotton is 8.4 and of Milkweed floss 22·3, and the corresponding initial specific buoyancies are therefore 7·4 and 21·3. These figures imply that 1 lb. of cotton packed reasonably tightly by hand would exert an upward thrust of about 7·4 lb. on first submersion in water, whilst a pound of Milkweed floss similarly packed would exert an upward thrust of 21·3 lb. ; or that the weight of cotton required to provide a certain initial upward thrust would be nearly three times that of Milkweed floss. It has been seen that the overall specific volume of the hollow fibres is very dependent upon their pressure histories, and the same is necessarily true of their initial specific buoyancy. The difference in specific volume shown by the Prime Java and Ceylon Kapoks in Table III must, for example, be reflected in a corresponding difference of specific buoyancy, but this is a result of the commercial handling of the materials, and not an intrinsic difference between the kapoks of different origins.

The rate of water-logging of a float is generally more important than its initial specific buoyancy. The practical requirement is for a certain specified upward thrust, and, within limits, it may not be of the highest importance whether this demands a float of a greater, or smaller, weight in air. It is, however, always of the greatest importance that the upward thrust shall not decrease rapidly when the float is immersed in water.

For observations of rate of water-logging a laboratory apparatus is required that enables the change in upward thrust to be observed when a standard float is kept submerged in water. The simple apparatus used is shown diagrammatically in Fig. 2. It consists of a cylindrical cage A made from perforated sheet metal, and provided with metal rings B soldered to each end. The cage can be closed top and bottom by circular sheet metal discs C held in position by clamps G. These discs carry hooks enabling the cage to be suspended from a balance, and to be weighted with a sinker S at the bottom. Two or more cages can be clamped together (the intervening metal discs being removed), and in this way the height of the unit can be varied. The actual cages in use were 4 cm. in diameter, some 10 cm. and others 20 cm. high; the volume of the shorter cage was approximately 125 c.c., and of the longer 250 c.c.

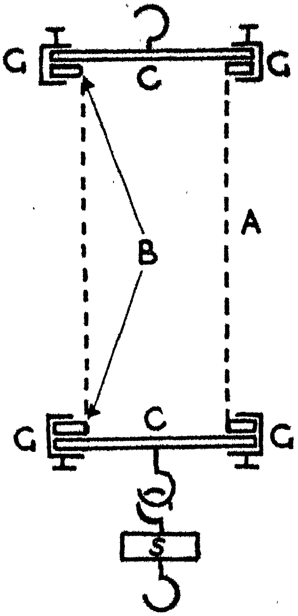

FIG. 2

The cage with its attached weight forms the sinker, and it is weighed in water, suspended from a balance arm. It is then packed at some selected density (or overall specific volume) with the buoyant fibre, which forms the float. It is again submerged in water and again weighed, the difference in weights giving the upward thrust. The apparatus is left suspended in water, and weighed at suitable intervals to obtain the percentage change in upward thrust with time. The temperature of the water used was thermostatically controlled at 25° C., and it contained 0·1 per cent. formaldehyde. The actual depth of submersion is, within small limits, unimportant, but in the experimental arrangement used the top circular metal disc was 2 cm. below the water surface.

The conditions of packing can only be described by the weight of the fibrous filling and the volume of the cage, that is, by the overall density or specific volume. The pressure is not known. The specific volumes obtained by the most convenient compact filling with different fibres were, however, of the orders shown in Table III, which corresponds to a pressure of 1·0 lb./sq. in.

12. RESULTS OBTAINED IN BUOYANCY MEASUREMENTS.

Of the many measurements made with the apparatus described, it is only possible to quote a few, illustrative of the most important conclusions.

(*a*) *The Effect of Displacement Pressure.*—The displacement pressure when the cage is first submerged is equal to its height, which was varied in different experiments with the same fibre fillings packed at the same density. The curves in Fig. 3 give the degree of water-logging after 24 hours in water at 25° C., and at

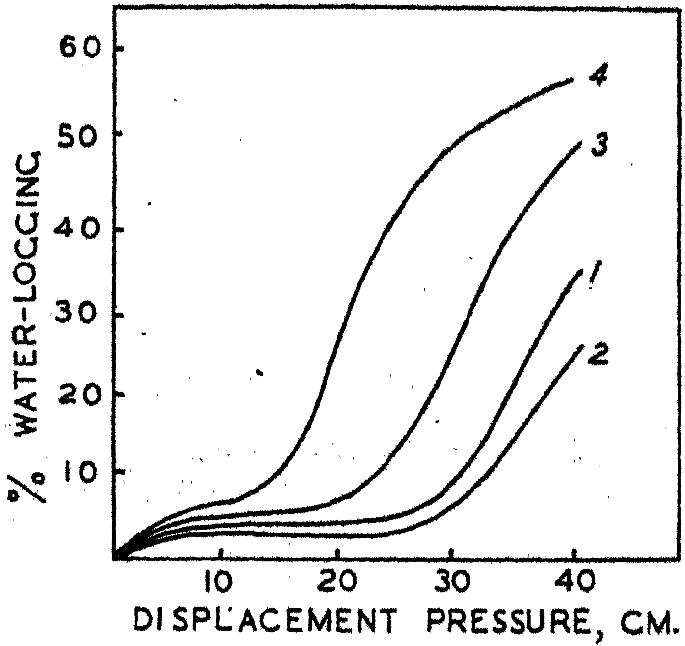

FIG. 3

1. Prime Java Kapok.
2. Sea Island Cotton.
3. Egyptian Cotton.
4. Indian Cotton.

different displacement pressures, of Prime Java Kapok and of three different cottons, namely, Indian, Egyptian and Sea Island. The kapok was packed at 18 c.c./gram, and the three cottons at 9 c.c./gram. The curves show that the effect of increasing displacement pressure is at first small, but that a value is ultimately reached beyond which a rapid rise occurs in the degree of water-logging. This is a somewhat critical value, and might be called the penetration pressure. At displacement pressures greater than the penetration pressure, the effects of surface tension are no longer sufficient to prevent penetration of water into the float. The bottom part of the float becomes water-logged, and the displacement pressure is thus automatically reduced below the penetration value. It can be seen from the figure that the penetration pressure is about 10 cm. of water for the Indian cotton, 20 cm. for the Egyptian cotton, and 25 cm. for the Sea Island cotton and the Prime Java Kapok. For the three cotton samples, the penetration pressure follows the same order as the fineness of the fibre, being greatest for the fine Sea Island and least for the coarse Indian (cf. fibre-weights in Table I).

It is difficult to exaggerate the importance of displacement pressure either in testing the buoyancy of fibres, or in the practical application of fibre floats. The assessment of the relative merits of different fibres will depend greatly on the displacement pressure at which the tests are made. It can be seen, for example, that the four kinds of fibres for which results are represented in Fig. 3 do not differ very greatly in their degree of water-logging at 10 cm. displacement pressure, but may differ very widely at higher values. For comparisons of other fibres with kapok, a displacement pressure of 20 cm. is a reasonable value since this is not far below the penetration pressure for Prime Java Kapok.

In the design of floats, the maximum submerged depth should be reduced to a minimum, and for Prime Java Kapok and similar fibres should never greatly exceed 20 cm. The volume necessary to provide the required upward thrust should be obtained by a maximum practicable horizontal cross-section. It may also be noted that the displacement pressure can be effectively reduced by dividing the float into compartments with horizontal impermeable partitions so that air cannot be conducted through the fibrous filling from the lower to the upper compartment. Thus, two filled cages similar to that shown in Fig. 2, each 20 cm. deep, superimposed one on top of the other and clamped together, *but with the intermediate metal disc C remaining in position,* constitute effectively two floats each of displacement pressure 20 cm. On total submersion they have the same initial upward thrust as a single filled cage 40 cm. deep (therefore of 40 cm. displacement pressure), but their degree of water-logging is much less at any time after submersion, being substantially the same as for a single 20 cm. float.

It is easy to show with the apparatus described that the water-logging of a deep float is principally confined to its lowest levels.

The 40 cm. deep cages were, for example, made up by clamping together two cages, each 20 cm. deep. At the end of an experiment the two can be separated, and their upward thrusts separately measured. Table VII shows the degree of water-logging, after 24 hours, of Prime Java Kapok, Egyptian and Indian cotton packed as described above, (a) in a float of 40 cm. displacement pressure, and (*b*) in the upper and lower halves of the same float.

Table VII

Fibre.	Degree of Water logging, per cent. after 24 hours. 40 cm. Float.	Upper 20 cm.	Lower 20 cm.
Prime Java Kapok . .	38	6	60
Egyptian Cotton . . .	50	8	90
Indian Cotton . . .	64	35	90

The degree of water-logging of the 40 cm. float is, as it should be, near to the mean for the two halves, which differ widely in the expected direction.

(*b*) *The Effect of Micro-biological Growth.*—When, with the experimental arrangement described, floats of kapok, Milkweed floss, or cotton are kept submerged in pure water at 25° C., the initial rate of water-logging is slow, but a relatively very rapid rise in degree of water-logging is always observed usually between the second and fourth day of submersion. At 20° C. the initial rate of water-logging is much the same as at 25° C., but no abnormal rise is generally observed during periods of submersion up to seven days. The abnormal rise at 25° C. is attributed to the development of micro-organisms at this favourable temperature, and to their effect on the wettability of the fibre surfaces. Evidence for this is found in the fact that if the pure water is replaced by 0·1 per cent. formaldehyde solution—an inhibitor, particularly of bacterial growth—there is little effect on the rate of water-logging at 20° C., but the rapid rise otherwise observed at 25° C. is completely eliminated in nearly all the cases examined. In illustration of this, Fig. 4 shows the degree of water-logging at 25° C. for floats made from the same Prime Java Kapok at a specific volume of 16·7 c.c./gram and a displacement pressure of 20 cm., submerged for different periods up to six days (1) in pure water, and (2) in 0·1 per cent. formaldehyde solution. Similar curves could be given for cotton and Milkweed floss. The choice of 25° C. as the standard temperature for buoyancy measurements was made before the large effects of micro-biological growth at that temperature were realised. These effects are generally observed only in periods of submersion exceeding one day, and they are generally eliminated by the use of formaldehyde. Nevertheless, anomalous results are occasionally obtained in long submersions at 25° C. that may be due to insufficient protection against the growth of organisms, and a lower temperature (15° or 20° C.) would be a better choice in a standard test, the use of the antiseptic being still retained.

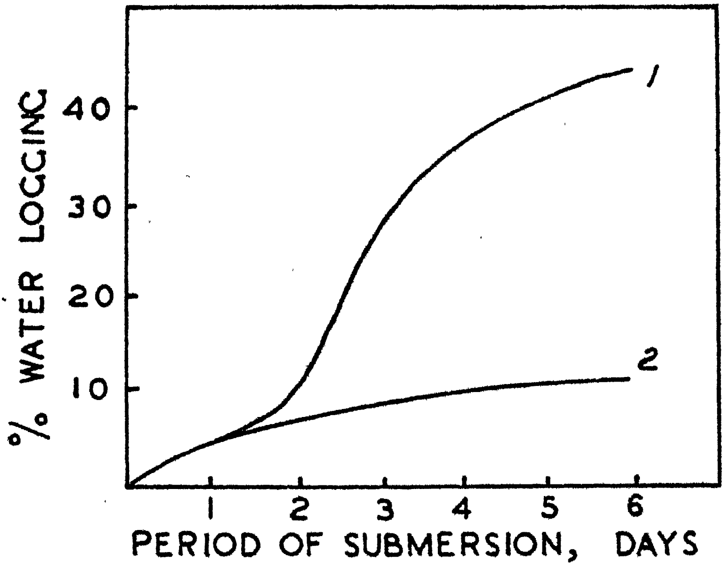

Fig. 4

Prime Java Kapok at 25°C.

1. In pure water.
2. In 0·1 per cent. formaldehyde.

(*c*) *Comparison of Different Fibres.*—It has already been sufficiently explained that the relative initial specific buoyancies of different fibres are determined purely by their relative overall specific volumes. Large differences are encountered attributable to variations in the history of the hollow fibres, and when these complications are avoided there is little difference in initial specific buoyancy between Milkweed floss and kapoks of different origins, that of cotton being much lower.

In respect of rate of water-logging, Prime Java Kapok gave the most consistent and lowest results, the degree of water-logging at 20 cm. displacement pressure in the apparatus described rarely exceeding 10 per cent. during three days submersion, and not greatly exceeding it during a week. Kapoks from other sources have given variable results, some of them as good as Prime Java Kapok, others considerably inferior. Unless the fibre is produced under conditions of careful cultivation, and its production standardised as far as possible, there can of course be no assurance that any particular sample is truly representative of the product from a given locality. If such cultivation and standardisation were ensured, there seems no reason to doubt that the buoyant properties of Prime Java Kapok could be attained in kapoks from other sources, for example, Ceylon.

For the sample of Milkweed floss examined, the rate of water-logging was appreciably greater than that of Prime Java Kapok at

20 cm. displacement pressure, though little different at 10 cm., and this material undoubtedly constitutes a reasonably effective buoyant filling.

The rate of water-logging of the fine-stapled cottons (Egyptian, Sea Island) is not very different from that of Milkweed floss, but the coarser-stapled cottons (Indian, American) water-log considerably more rapidly at displacement pressures above 10 cm. When a cotton float that has been partly water-logged is dried, the volume of the fibre mass, and hence its specific buoyancy, may be found to be considerably below their original values. The compacting of the fibre mass under this treatment may be a result of the swelling and deconvolution of the cotton hairs in water, and the consequent greater cohesion of the fibres when the mass is dried. This constitutes a serious disadvantage of cotton as a buoyant filling, compared with kapok or Milkweed floss.

The rate of water-logging of Akund is so great that the degree of water-logging exceeds 50 per cent. in a few hours at 20 cm. displacement pressure. These are conditions under which the observed initial specific buoyancy is somewhat indeterminate, and is always lower than the theoretical value calculated from the overall specific volume.

13. FLOATS WITH NON-RIGID COVERS. LIFEJACKETS.

Lifejackets commonly consist of cotton fabric covers more or less rectangular in form, filled with kapok. A float of this kind differs in one important respect from the filled cage illustrated in Fig. 2 used as a standard float in the experimental investigation of buoyancy; namely, its walls are not rigid, and the enclosed fibre can increase in volume by causing the shape of the cover to alter in the direction of a more cylindrical, and less cushion-like, form. It has been seen that kapok which, in its early history, has been submitted to sufficiently high pressure increases in specific volume at a constant pressure when subjected to a high humidity, a condition that occurs when a lifejacket is floated on water. In a rigid case the increase of volume cannot occur, and therefore the pressure inside the case must rise. But in a non-rigid cover some increase in volume is possible, though its amount is limited by the resistance of the cover to distortion, or to extension. The consequent rise in specific volume must result in a gradual rise of specific buoyancy, or of upward thrust, as the kapok—originally in equilibrium with air at normal humidities—slowly comes into equilibrium with the water-saturated atmosphere in the neighbourhood of the water surface. The effect is opposite in direction to that produced by water-logging, and may compensate or even over-compensate, for it, so that the buoyancy of the lifejacket may actually rise as its time of immersion in water increases. Under these conditions, the change in upward thrust is not a measure of degree of water-logging. The increase in volume is of course limited, whilst the water-logging is not, so that a fall in buoyancy must eventually set in after a sufficient period of immersion. These effects have been clearly demonstrated in a systematic investigation of lifejackets.

The standard lifejacket is specified as containing 1½ lb. of Prime Java Kapok distributed equally between two fabric pockets of specified dimensions. The practical test prescribed for its official inspection [4] consists in observing its behaviour on floating with 16½ lb. of iron attached to it. Since 16½ lb. of iron weighs about 14½ lb. in water, and since the upward thrust of the standard lifejacket is generally between 22 lb. and 23 lb. it floats under this load with about two-thirds of its bulk submerged. For a float on the surface of water, the initial displacement pressure is the distance from the water surface to the lowest point on the float, and it is in the neighbourhood of 10 to 15 cm. for the standard lifejacket loaded in the manner described. The upward thrust of a lifejacket can of course be measured as for any other float. At desired intervals, the load on the floating jacket is increased so as to form a sinker sufficiently heavy to submerge it, and the weight of the combination, and that of the sinker separately, are determined, most conveniently with a spring balance. The displacement pressure is greater for the submerged, than for the floating jacket, so that it should not be kept submerged for longer than is necessary to make the measurement.

Table VIII contains the results of observations made on three lifejackets consisting of the specified cover filled with 1½ lb. of Prime Java Kapok (the standard lifejacket), and with equal weights of Ceylon Kapok and of Milkweed floss. The jackets were floated under the conditions described above, and their upward thrusts are recorded for periods of floating of three hours, one, three and seven days. The upward thrust after three hours floating is taken as the initial value, that observed immediately after immersion of the jackets being a little indefinite owing to the slow wetting of the fabric cover. The upper half of the table contains the results of floating the jackets for a week (first immersion); the lower half (second immersion) gives the results obtained on the same jackets stove-dried to their original weights following their first immersion, and refloated for a second week. under the same conditions as before

TABLE VIII

Time of Floating.	Upward Thrust in lb. of lifejackets containing 1½ lb. of fibre.		
	Prime Java Kapok.	Ceylon Kapok.	Milkweed Floss.
First Immersion:			
3 hours	22·4	27·7	26·9
1 day	23·2	27·3	25·3
3 days	23·4	26·8	24·2
7 days	23·1	26·4	23·6
	Gain 0·7	**Loss 1·3**	**Loss 3·3**
Second Immersion:			
3 hours	24·2	27·3	24·2
1 day	23·8	26·7	23·6
3 days	23·6	26·3	23·0
7 days	23·4	26·0	22·5
	Loss 0·8	**Loss 1·3**	**Loss 1·7**

The results are given in the table as upward thrusts in lb., but they could be expressed as specific buoyancies by dividing all the figures by 1·5, the weight of the filling in lb. The results for the Prime Java Kapok in the first immersion show that it first increases in buoyancy so that after three days floating it has an upward thrust greater by 1 lb. than the original. A very slow fall in upward thrust then sets in, but the result of floating for a week is still a net gain of 0·7 lb. in upward thrust. After stove-drying, the Prime Java Kapok shows a higher initial upward thrust in its second immersion than in its first, but there is a steady fall of upward thrust throughout the second immersion, and a net loss of 0·8 lb. as a result of floating for a second week ; even at the end of the second week, however, the upward thrust remains higher than the initial value in the first immersion.

The Ceylon Kapok differs from the Prime Java in the following respects. The initial upward thrust in the first immersion is higher by 5·3 lb. The upward thrust falls, however, consistently throughout the first immersion, and there is a net loss of 1·3 lb. during floating for the first week. On stove-drying and re-immersion, the Ceylon Kapok nearly, but not quite, recovers the initial upward thrust shown in the first immersion, and the second week of floating is accompanied by the same loss as the first.

These results are precisely parallel to, and are explained by, those obtained in the measurements of overall specific volume already discussed. The Prime Java Kapok was taken as a finished product from the bale, where it had been subjected to pressure. The Ceylon Kapok was used immediately after its machine-processing without subsequent baling. It therefore had a higher specific volume than the Prime Java, and hence showed a higher initial specific buoyancy, or upward thrust, in the lifejacket. When the Prime Java Kapok is exposed to a high humidity during the flotation of the jacket its specific volume tends to recover from the effects of its pressure history, and its buoyancy therefore rises. The variation of the upward thrust with time is then complex, being a composite result of two opposite effects, that of increasing volume and of normal water-logging. The stove-drying of the jacket and its repeated immersion resembles the cyclic humidity/temperature treatment of Section 8, and produces the greatest volume recovery ; corresponding to this, the buoyancy attains a maximum at the beginning of the second immersion, during which there is little further increase in volume, and no increase in buoyancy. There may be a further slight recovery in volume during the second immersion, but it is not sufficient to affect the general downward trend of upward thrust characteristic of normal water-logging. The actual loss in upward thrust during the second immersion will, nevertheless, slightly underestimate the true degree of water-logging if a slight further recovery has occurred.

None of these effects are observed with the Ceylon Kapok because the fibres have not been seriously strained in a semi-permanent way by imposed pressures, and hence little recovery of volume can occur. The loss in upward thrust is probably a fairly reliable measure of the degree of water-logging of the Ceylon Kapok, which is then a little below 5 per cent. during floating for a week.

The results obtained for the Milkweed floss are very similar to those for the Ceylon Kapok, except that the rate of water-logging as measured by the loss in upward thrust during floating for a week is slightly greater. The initial buoyancies of the two, like their overall specific volumes, are very near, and there is again no evidence of semi-permanent strain in the fibres such as are released in atmospheres of high humidity.

As a result of the high specific volumes of the Ceylon Kapok and the Milkweed floss, the hand-packing of 1½ lb. of these fibres into a standard cover was much more difficult than the packing of 1½ lb. of Prime Java into the same cover; it requires so much more time and effort that it would not be practicable in bulk production. If, by reduction of the weight of filling, the packing were made equally convenient to that of 1½ lb. of Prime Java Kapok, the volume, and therefore the initial upward thrust, would of course be correspondingly reduced. For example, a standard lifejacket cover filled with 1¼ lb. of Milkweed floss and floated under the conditions described previously gave the results recorded in Table IX.

TABLE IX

Time of floating . . .	3 hours	1 day	3 days	7 days
Upward Thrust . . *lb.*	22·2	21·1	20·0	19·3
				Loss 2·9

The initial upward thrust is now very similar to that of the Prime Java Kapok in Table VIII. The degree of water-logging in a week is 13 per cent., which is nearly the same as for the Milkweed floss in Table VIII packed at the higher density.

The use, as a filling for lifejackets, of kapok that has a relatively low specific volume (as a result of pressure treatment) has certain obvious advantages. The low specific volume facilitates the packing of a given weight into a specified volume, whilst under service conditions—floating in water—the volume recovery results in an increase of buoyancy. That the difference between the Prime Java and Ceylon Kapoks shown in Table VIII is due to the history, and not to the intrinsic quality, of the fibres is finally shown by experiments with lifejackets filled with Ceylon Kapok baled after machine-processing, in imitation of the normal treatment of Prime Java. Table X gives the results of experiments similar to those already described, but with a standard lifejacket cover filled with Ceylon Kapok baled after final processing to a density of 17 lb./cu. ft.; the kapok was otherwise the same as that for which results were given in Table VIII. It may be emphasised that all fillings for lifejackets are well teased out by hand before insertion, as they are before a specific volume measurement.

TABLE X

Time of floating.		3 hours	1 day	3 days	7 days	
Upward Thrust, lb.						
1st Immersion	.	24·2	24·0	25·0	24·8	Gain 0·6
2nd Immersion	.	25·7	25·5	25·2	25·0	Loss 0·7

The results are very similar to those recorded for the Prime Java in Table VIII. The initial upward thrust is a little higher, but the behaviour of the Prime Java and Ceylon Kapoks is identical in respect of the rise in buoyancy during the first immersion, the attainment of a maximum at the start of the second immersion after stove-drying, and the fall in buoyancy during the second period.

14. SOME PRACTICAL CONCLUSIONS.

Most of the Empire kapoks examined were not available in sufficient quantity for convenient machine-processing. They had reached this country at best in a hand-cleaned condition, and large-scale comparisons (which are sometimes made) between kapoks in this condition and Prime Java necessarily lead to disappointing results. The beneficial effect of the machine-processing is not merely in its cleaning action, but also in the opening up of the denser fibre aggregates, and in the production of a more homogeneous product of greater filling capacity. Ceylon Kapok, to the grading of which some attention appears to be paid, has been examined in a fairly comprehensive way. The material used in this investigation was imported as "double hand-cleaned," but machine-processing was essential in order to obtain the best results. After efficient machine-processing, the samples of Ceylon Kapok examined showed no intrinsic difference from Prime Java in buoyancy, filling capacity, or any fibre characteristic, and it seems likely that this would also be true of kapoks from some other sources.

Kapoks that are not grown under conditions of controlled cultivation have sometimes been suspected of admixture with other fibres of inferior buoyant properties such as Akund, an admixture that is not easy to detect with certainty in bulk deliveries. They may also be more variable in quality owing to variations in the maturity of the fibre, and in the extent of damage by weather or pests. These aspects of the problem have not come within the scope of this investigation, which is only concerned with showing that kapoks can be obtained from sources other than Java of such a quality as to be indistinguishable, after suitable processing, from Prime Java Kapok in any of the properties examined here.

Acknowledgment has already been made of the important contribution of Mr. W. H. Rees, of the British Cotton Industry

Research Association, to this study of kapok. Measurements of buoyancy, and of some other properties were made by Mr. G. Hughes, and other members of the staff of this Institute have made valuable contributions. The author is indebted to Messrs. Harrison and Jones, Ltd., of Liverpool, for their courtesy, practical advice, and generous co-operation. Finally, the work was rendered possible only through the assistance of the Director General of Scientific Research and Development, Ministry of Supply.

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NOTES

Mr. F. Ferrar, M.A. (Cantab.).—The Imperial Institute has lost the services of another senior member of the staff through the retirement last June of Mr. F. Ferrar.

Mr. Ferrar joined the Institute in December 1914 as an assistant in the Intelligence Section, Plant and Animal Products Department (then known as the Technical Information Bureau). After serving for over 18 years as a senior assistant in this section he became its Vice-Principal in August 1944, and on the same date took over the editorship of the BULLETIN of the Imperial Institute.

The Determination of Pyrethrins.—A few years ago the Imperial Institute started a collaborative study with Rothamsted Experimental Station of the various methods then known of determining the pyrethrin content of pyrethrum flowers, concentrates and spray. As a result of this work, carried out by Dr. J. T. Martin and S. T. P. Brightwell, it has been found that slight modification of the mercury reduction method originally described by Wilcoxon and Holaday gives the most satisfactory results. Working details for carrying out this modified Wilcoxon-Holaday method have been drawn up not only for the evaluation of pyrethrum flowers, but also for concentrates and spray. More recently as a result of the claim made by J. J. T. Graham and F. B. La Forge (*Soap*, 1943, **19**, 111) that the factor for pyrethrin I in terms of M/100 potassium iodate solution as used by Wilcoxon and Holaday was too low, further collaborative work has been carried out by these two institutions (K. A. Lord, G. T. Bray and F. Major), in conjunction with Dr. T. F. West and F. H. Tresadern (of Messrs. Stafford Allen & Sons Ltd.) and Dr. S. H. Harper of University College, Southampton. This more recent study corroborates the factor found by Graham and La Forge, namely, that 1 ml. M/100 potassium iodate solution is equivalent to 5·7 mgm. of pyrethrin I.

The results obtained in both these collaborative studies are being incorporated in three papers, which it is hoped will be published shortly in a scientific journal. These collaborative studies were carried out under the direction of a consultative panel, consisting of Dr. F. Tattersfield and Dr. J. R. Furlong in addition to those named above.

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FORESTRY

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The Identification of Burma Commercial Timbers. By K. Ahmad Chowdhury. *Indian For. Rec.* (*New Series*) *Utiliz.*, 1945, **3,** No. 6. Pp. 27, 8½ × 5½. (Dehra Dun, U.P. : The Forest Research Institute, 1945.) Price As. 12.

Notes on Insect Damage to East African Timbers. By T. W. Kirkpatrick. Pp. 31, 9½ × 6. (Nairobi : East African War Supplies Board, 1944.) Price Shs. 2/50.

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Dry Rot in Wood. 4th. Ed. By K. S. G. Cartwright and W. P. K. Findlay. *Bull. No.* 1, *For. Prod. Res.* Pp. 32, 9½ × 6. (London : H.M. Stationery Office, 1945.) Price 1*s.*

Chemical Impregnation of Trees and Poles for Wood Preservation. By

B. H. Wilford. *Circ. No.* 717, *U.S. Dep. Agric.* Pp. 30, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1944.) Price 10 cents.

The Toxicity and Penetrative Capacity of Certain Pentachlorophenol Wood Preservative Solutions. By P. M. D. Krogh and F. G. C. Tooke. *J.S. Afr. For. Assoc.*, 1944, No. 12, 52-59.

Plywood Industry in India. By S. N. Kapur and S. Datta. *J. Sci. Industr. Res., India*, 1944, **3**, No. 4, 167-177.

Tanning Materials

Mexican Buttonwood [*Conocarpus erecta*] Resources Explored. By F. M. Coston. *Foreign Comm. Wkly.*, 1945, **19**, No. 4, 5-6. Discusses the possibilities of bark and wood of the tree as a source of tanning material.

Vegetative Propagation of Tan Wattles. By M. S. J. Ledeboer. *J. S. Afr. For. Assoc.*, 1944, No. 12, 29-32.

IMPERIAL INSTITUTE

CONSULTATIVE COMMITTEE ON INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

QUARTERLY BIBLIOGRAPHY ON INSECTICIDE MATERIALS OF VEGETABLE ORIGIN, NO. 31

(April to June 1945)

Compiled by Miss R. M. Johnson

With the collaboration of the Imperial Institute of Entomology and the Department of Insecticides and Fungicides, Rothamsted Experimental Station.

GENERAL

Report of the Administrator of Agricultural Research, U.S. Dep. Agric., 1943-44. (Contains the Report of the Bureau of Entomology and Plant Quarantine.) References to the following: repeated evening spraying of apple trees with nicotine sulphate killed many codling moths, but not so effective as DDT (p. 125); tests of mineral oil emulsions atomized on the maize ear silks showed that there is a possibility of controlling the earworm by this method at less cost than when the oil-injection method is used (p. 132); dusting of early-market sweet corn with ground derris controlled the European corn borer and gave increased yields (p. 134); in tests directed against cabbage caterpillars some insecticidal value justifying further tests was shown for yam bean flour, various nicotine combinations and a low rotenone-containing product from *Derris malaccensis* (p. 136); in combating the pea aphid dusts containing nicotine sulphate or rotenone combined with either nicotine or an organic thiocyanate proved less effective than dusts containing rotenone as the only active ingredient (p. 136); tests to determine the relative efficiency against the Mexican bean beetle of ground derris or cube roots mixed with a diluent and impregnated dust mixtures formed by depositing rotenone on the particles of the diluent showed no differences in the results (p. 136); the addition of nicotine to calcium arsenate to prevent the build-up of aphids increased the yields of seed cotton (p. 138); for use about kennels and other locations where some temporary burning of foliage is not objectionable a water spray containing 0.05 per cent. nicotine and 1.5 per cent. sodium fluoride killed all stages of *Ixodes ricinus scapularis* and *Dermacentor variabilis* (p. 143); rotenone extenders recommended for cattle grub control (p. 144); improvements in the control of lice on livestock by the addition of wettable sulphur to rotenone in water (p. 145); in toxicity tests comparing the effectiveness of pyrethrum in an aerosol and in a deodorized kerosene spray, the aerosol was found to be superior (p. 147); pyrethrum still remains the outstanding insecticide for the destruction of the adult mosquito (p. 147); anethole can be substituted for geraniol and pimento-leaf oil for eugenol in Japanese beetle bait without adverse effect (p. 149); extracts of the plant *Erigeron affinis* DC. proved very toxic to houseflies and to some other insects.

Bean Pests in Queensland. By N. E. H. Caldwell. *Queensld. Agric. J.*, 1945, **60**, Pt. 3, 156-171. Nicotine recommended for the control of bean flies, thrips and aphids; applications of derris or nicotine for pod-eating caterpillars and various species of bugs.

The Onion Thrips (*Thrips tabaci* Lind.). By Khan A. Rahman. *Indian J. Agric. Sci.*, 1944, **14**, Pt. 4, 308-310. Gives particulars of the efficacy of different insecticides (concoctions of tobacco, Ak, Nim, Dhatura; sprays of nicotine and derris; and nicotine and other dusts).

Effects of Paralytic Insecticides on Heart Pulsations and Blood Circulation in the American Cockroach as determined with a Fluorescein Indicator. By B. F. Coon. *J. Econ. Ent.*, 1944, **37**, No. 6, 785-789. Discusses the effect of pyrethrum and nicotine on the cockroach.

Control of the Cotton Aphid with Different Forms of Rotenone and Nicotine. By J. C. Gaines. *J. Econ. Ent.*, 1944, **37**, No. 6, 728-729.

Latent Injury from Pyrethrum and Rotenone Dusts. By H. L. Sweetman and G. G. Gyrisko. *J. Econ. Ent.*, 1944, **37**, No. 6, 746-749. Tests carried out with these dusts on firebrats.

38th. Ann. Rep. Dep. Agric. Brit. Columbia, 1943. (*R.A.E.*, 1945, **33**, A, Pt. 5, 153-154.) Tarnished plant bug easily killed by pyrethrum dust or derris dust; in tests on the control of the cherry aphis and the mealy plum aphis spray of nicotine sulphate and dormant oil effective.

Rep. Cocoa Res. Sta. Tafo, 1938-42. (*R. A.E.*, 1945, **33**, Pt. 3, 66.) In experiments on the control of capsids sprays of nicotine were satisfactory; also dusts of pyrethrum and a mixture of derris and nicotine.

Squash Bug Depredations in Washington. By R. D. Eichmann. *J. Econ. Ent.*, 1945, **38**, No. 1, 110-112. Nicotine and pyrethrum dusts used for control.

Histological Effects of Certain Sprays and Activators on the Nerves and Muscles of the Housefly. By A. Hartzell. *Contrib. Boyce Thompson Inst.*, 1945, **13**, No. 9, 443-454. Among the materials tested were pyrethrins, piperine, sesame oil and rotenone alone and in combination.

Toxicité vis-à-vis des larves de moustiques de quelques insecticides solubles ou émulsionnables. By E. Roman. *C.R. Soc. Biol.*, 1943, **137**, No. 15-16, 499. (*R.A.E.*, 1945, **33**, B, Pt 4, 64.) Rotenone destroyed mosquito larvae in septic tanks without affecting the bacteria: pyrethrum also satisfactory but too expensive.

Dispenser for Aerosols and Highly Volatile Fumigants. By F. F. Smith, L. D. Goodhue and W. R. Ballinger. *U.S. Dep. Agric., Bur. Entomol.* ET-216, 1944. (*Amer. Chem. Absts.*, 1945, **39**, No. 8, 1727.)

Dispersants for Aerosols. By L. D. Goodhue, J. H. Fales and E. R. McGovern. *Soap*, 1945, **21**, No. 4, 123-127.

Compatibility of DDT with Insecticides, Fungicides and Fertilizers. By E. E. Fleck and H. L. Haller. *Industr. Engng. Chem., Industr. Ed.*, 1945, **37**, 403-405.

Some Modifications of Procedure when using Eggs of *Aphis pomi* (de Geer) for the Biological Evaluation of Insect Ovicides. By P. H. Tuft. *Ann. Rep. E. Malling Res. Sta.*, 1943, 67-68.

Effect of Pretreatment on the Toxicity of Insecticidal Films on Building Surfaces. By P. S. Hewlett and E. A. Parkin. *Nature*, 1945, **155**, No. 3947, 755-756.

Insecticide Situation in the Pacific Northwest. By R. L. Webster. *J. Econ. Ent.*, 1944, **37**, No. 6, 818-821.

Wholesale Prices of Insecticides During World War I and II. By E. R. de Ong and M. D. Leonard. *J. Econ. Ent.*, 1944, **37**, No. 6, 854-855.

Markets Abroad for American Insecticides. By L. N. Markwood. *Foreign Comm. Wkly.*, 1945, **19**, No. 9, 7-11. Discusses the position for the insecticide materials of vegetable origin commonly in use.

ALKALOID-CONTAINING MATERIALS

Tobacco Products, including Nicotine and Nicotine Derivatives

Evaluation of Codling Moth Insecticides. By J. L. Brann. *Proc. N. Y. St. Hort. Soc.*, 1944, **89**, 170-179. (*R. A. E.*, 1945, **33**, A, Pt. 5, 149.) Discusses the use of nicotine in the spraying schedule.

Report of Progress with Dusting for Codling Moth Control. By D. W. Hamilton. *Proc. N. Y. St. Hort. Soc.*, 1944, **89**, 180-185. (*R. A. E.*, 1945, **33**, A, Pt. 5, 149-150.) The best results were obtained with dusts to which nicotine-bentonite had been added.

The Effect of the War on Truck Crop Insect Control in California. By W. H. Lange. *J. Econ. Ent.*, 1944, **37**, No. 6, 734-737. Refers to the success of nicotine dust against the cabbage aphid and caterpillar, and nicotine spray for thrips on onions and beans.

Pear Midge (*Contarinia pyrivora*). *Adv. Leafl. No.* 26, *Minist. Agric., Lond.*, 1945. Nicotine wash at the early white-bud stage recommended for control.

Canker and Mosaic of Broccoli. By W. A. Millard. *J. Minist. Agric.*, 1945, **52**, No. 1, 39-42. Spraying with nicotine recommended to control aphis.

The Leek Moth. By S. G. Jary and S. W. Rolfe. *J. Minist. Agric.*, 1945, **52**, No. 35-37. Use of dusts or sprays containing nicotine has given good results especially for the control of attacks in seed beds.

Factors Influencing Control of the Walnut Aphid. By A. E. Michelbacher and C. Swanson. *J. Econ. Ent.*, 1945, **38**, No. 1, 127-128. Nicotine used.

Field Tests with Fixed Nicotine for the Control of Sheep Ticks, *Melophagus ovinus*. By N. G. Cobbett and C. E. Smith. *Amer. Vet.*, 1944, **25**, 536-8. (*Amer. Chem. Absts.*, 1945, **39**, No. 5, 1014.)

Diseases of Animals: Prevention and Treatment. By T. Dalling. *J. Roy. Agric. Soc. England*, 1944, **105**, 13-23. Mentions cases of poisoning of animals after use of nicotine and lime dressings for warbles.

Development of Commercial Lecithin. By M. Schofield. *Manuf. Chem.*, 1945, **16**, No. 4, 135-137. Brief reference to the use of lecithin as an emulsifying agent in sprays to enhance the toxicity of nicotine. (U.S. Pat. No. 2,006,227.)

Die Tabakwurzel als Bildungsstätte des Nikotine. By K. Mothes and K. Hieke. *Naturwissenschaften*, 1943, **31**, No. 1-2. (*Hort. Absts.*, 1945, **15**, No. 1, 19.) The formation of nicotine in the root of the tobacco plant.

Nicotine Compounds Suitable for Combating Insects on Vegetation. U.S. Pat. No. 2,346,185. *Amer. Chem. Absts.*, 1945, **39**, No. 1, 150.

INSECTICIDE MATERIALS CONTAINING ROTENONE AND ALLIED SUBSTANCES

General

Rep. Puerto Rico Exp. Sta., 1943. Gives an account of agronomic, propagation and chemical studies on derris and lonchocarpus (pp. 9-19).

Laboratory Tests of Toxicity of Some Organic Compounds to the European Corn Borer, 1941-1943. By D. D. Questel and S. I. Gertler. *U.S. Dep. Agric., Bur. Entomol.* E-612, 1944. (*Amer. Chem. Absts.*, 1945, **39**, No. 8, 1724-1725.) None of the 45 compounds tested compared favourably with preparations of ground rotenone-bearing roots containing 5 per cent. rotenone.

Flea Beetles. By F. R. Petherbridge and W. A. R. D. Weston. *J. Minist. Agric.*, 1945, **52,** No. 1, 37-39. Dusts containing derris and lonchocarpus have given the best control.

Effect of Rotenone and Velsicol (AR.60) Dusts on the Control and Reproduction of Bean Aphids. By Yun-Pei Sun. *J. Econ. Ent.*, 1945, **38,** No. 1, 124-125. In tests of insecticides it was found that rotenone-talc dusts stimulate the reproduction of bean aphids (*Aphis rumicis*).

Preparation and Use of Dusts, Sprays, Washes and Dips containing Rotenone for the Destruction of Cattle Grubs. *U.S. Dep. Agric., Bur. Entomol.* E.623, 1944. (*Amer. Chem. Absts.*, 1945, **39,** No. 8, 1729.)

Improved Dip for Sheep Ticks. *Chem. Engng. News, News Ed.*, 1945, **23,** No. 3, 288. Derris or cube powder in water.

Rotenone and Ox Warble Control. By M. A. Stewart. *J. Econ. Ent.*, 1944, **37,** No. 6, 756-760.

Comparative Effects of Spray and Dust Treatments on European Corn Borer. By D. D. Questel. *J. Econ. Ent.*, 1945, **38,** No. 1, 52-56. Rotenone used for control.

Approved Proprietary Insecticides. *Chem. and Drugg.*, 1945, **143,** No. 3400, 360-361. Includes lists of firms making approved derris and lonchocarpus dusts and sprays.

Derris

Control of Mexican Bean Beetle and Corn Earworm in the Presence of Powdery Mildew on Snap Beans. By L. W. Brannon. *J. Econ. Ent.*, 1945, **38,** No. 1, 101-102. Discusses the successful use of derris, cryolite and sulphur.

Field Tests with Insecticides to Control the European Corn Borer in Early Market Sweet Corn at Toledo, Ohio, in 1943. By D. D. Questel. *U.S. Dep. Agric., Bur. Entomol.* E-609, 1944. (*Amer. Chem. Absts.*, 1945, **39,** No. 8, 1725.) Best results obtained with standard ground derris spray. Derris dusts or sprays more effective than those containing nicotine.

Changes in California Red Scale Populations following Sprays of Oils with and without Derris Resins. By A. W. Cressman and B. M. Broadbent. *J. Econ. Ent.*, 1944, **37,** No. 6, 809-813.

The Effect of Various Diluents on the Toxicity of Derris Dust to House Flies (*Musca domestica* L.). By F. E. Whitehead. *Proc. Okla. Acad. Sci.*, 1944, **24,** 27-28. (*R.A.E.*, 1945, **33,** B, Pt. 3, 48-49.)

Comparative Effects of Spray and Dust Treatments on European Corn Borer. By D. D. Questel. *J. Econ. Ent.*, 1945, **38,** No. 1, 52-56. Derris the insecticide used in the tests.

The Widespread Appearance of *Apion aestivum* Germ. in the District of Nusum. By K. Lindemuth. *Nachr. Dtsch. Pflanzenschutzdienst*, 1942, **22,** 55-56. (*Amer. Chem. Absts.*, 1945, **39,** No. 2, 384.) Good results obtained with derris on the control of the weevil.

Toxicity of Extracts of Derris Root for Mice. By H. B. Haag, I. Taliaferro and L. D. Goodhue. *Soc. Expt. Biol. and Med. Proc.*, 1943, **54,** No. 1, 140-141. (*Exp. Sta. Rec.*, 1945, **92,** No. 5, 676.)

Derris Agronomy: An Annotated Bibliography and a Critical Review. Part III. By R. E. Moreau. *E. Afr. Agric. J.*, 1945, **10,** No. 4, 243-250.

Derris Culture in Puerto Rico. By R. H. Moore. *Circ. No.* 24, *P.R. Exp. Sta.*, 1943.

PYRETHRIN-CONTAINING MATERIALS

Constituents of Pyrethrum Flowers. XVII. By F. B. LaForge and W. F. Barthel. *J. Org. Chem.*, 1945, **10,** No. 2, 106. Deals with the new conception of the chemical nature of the pyrethrins.

Constituents of Pyrethrum Flowers. XVIII. By W. F. Barthel and F. B. LaForge. *J. Org. Chem.*, 1945, **10,** No. 2, 114.

Experiments on the Synthesis of the Pyrethrins. Part I. Synthesis of Chrysanthemum Monocarboxylic Acid. By I. G. M. Campbell and S. H. Harper. *Chem. and Ind., Lond.*, 1945, No. 13, 103. Summary of a paper on the subject read at the Chemical Society, London.

Purification of Pyrethrum Extract. U.S. Pat. No. 2,372,183. *Soap,* 1945, **21,** No. 5, 65.

Terpin Diacetate as an Activator for Pyrethrum. By R. L. Pierpont. *J. Econ. Ent.*, 1945, **38,** No. 1, 123-124.

Pyrethrum: A Kenya Contribution to Health. Progress of a relatively new industry that has replaced Japan in a vital field. By H. J. Holman. *Crown Colonist,* 1945, **15,** No. 161, 237-239. Brings the information on this subject up to date.

Pyrethrum Flowers from Nigeria. By F. Major. *Bull. Imp. Inst.*, 1945, **43,** No. 1, 7-8.

Ann. Rep. Coun. Sci. Industr. Res., Australia, 1943-44, p. 17. Refers to investigations undertaken into various means of increasing the effectiveness of fly-sprays containing pyrethrins by means of activators. Essential oils of *Backhousia myrtifolia, Zieria smithii, Melaleuca bracteata* and *Dacrydium franklinii* were found effective: *Backhousia* was many times more effective than sesame oil; considerable areas of pyrethrum have been established in the Mildura district and harvesting machinery is being adapted to deal with the crop.

Memorandum of Information on Insecticides used against Lygus Bugs on Sugar Beets grown for Seed. By O. A. Hills. *U.S. Dep. Agric., Bur. Entomol.* E-635, 1945. (*Amer. Chem. Absts.*, 1945, **39,** No. 8, 1727.) A pyrethrum dust and sulphur mixture did not give such good control as a dust of DDT and pyrophyllite.

The Use of Insecticides on Men Artificially Infested with Body Lice. By W. A. Davis and C. M. Wheeler. *Amer. J. Hyg.*, 1944, **39,** No. 2, 163-176. (*R.A.E.*, 1945, **33,** B, Pt. 3, 29-30.) Mainly deals with synthetic compounds, but one experiment included the use of pyrethrins.

Studies on the Population of Head lice *Pediculus humanus* var. *capitis* DeG. By D. N. Roy and S. M. Ghosh. *Parasitology,* 1944, **36,** No. 1-2, 69-71. (*R.A.E.*, 1945, **33,** B, Pt. 3, 31.) Pyrethrum extract and kerosene mixture used in the experiment.

Rep. Actg. Chief Entomologist, S. Rhodesia, 1943. (*R.A.E.*, 1945, **33,** A, Pt. 4, 126-127.) *Ephestia elutella* in stored tobacco factory controlled by pyrethrum spray: treatment not successful against *Lasioderma serricorne.*

Mosquito Control in Shelters. By A. R. Prendel. *Med. Parasitol. U.S.S.R.*, **9,** 637-8. (*Soap,* 1945, **21,** No. 5, 121.) Pyrethrum dusts recommended for living quarters.

Experimental Impregnation of Underwear with Pyrethrum Extract for Control of Body Lice. By H. A. Jones, L. C. McAlister, R. C. Bushland and E. F. Knipling. *War. Med.*, 1944, **6,** No. 5, 323-326. (*Exp. Sta. Rec.*, 1945, **92,** No. 5, 684-685.)

Toxicity of DDT and Pyrethrum to *Chaoborus punctipennis.* By A. W. Lindquist and R. C. Bushland. *J. Econ. Ent.*, 1944, **37,** No. 6, 842.

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Pyrethrum Planted in Antioquia, Colombia. *Agric. in Americas,* 1945, **5,** No. 4, 76. Plantings made in the agricultural experiment stations at Rionegro and Yarumal.

Pyrethrum Crop to be Increased in Peru. *Foreign Comm. Wkly.*, 1945, **19,** No. 6, 28-29.

OTHER INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

Derivatives of Piperic Acid and Their Toxicities Towards Houseflies. By M. E. Synerholm, A. Hartzell and J. M. Arthur. *Contrib. Boyce Thompson Inst.*, 1945, **13**, No. 9, 433-442.

New Insecticide Plant Established in Lima. *Agric. in Americas*, 1945, **5**, No. 3, 56. Factory to manufacture "Babbini," an insecticide composed of chili pepper, sabadilla, arsenic and quicklime and used against pests of cotton.

Cashew Nut Shell Liquid. Comparison of the Monophenol Isolated from Commercial Raw Cashew Nut Shell Liquid and from Commercial Cardanol. By D. Wasserman and C. R. Dawson. *Industr. Engng. Chem., Industr. Ed.*, 1945, **37**, 396-399.

Insecticidal Properties of Mamey [*Mammea americana*] and Other Plants in Puerto Rico. By H. K. Plank. *J. Econ. Ent.*, 1944, **37**, No. 6, 737-739.

A New Plant Insecticide for Control of the European Corn Borer. By B. P. Pepper and L. A. Carruth. *J. Econ. Ent.*, 1945, **38**, No. 1, 59-66. A material prepared from *Ryania speciosa* was found to be toxic to certain insects, especially the corn borer. Gives particulars of the relative effectiveness of this material (Ryanex) compared with rotenone, nicotine and DDT.

Preliminary Tests with Sabadilla. By E. H. Fisher and W. W. Stanley. *J. Econ. Ent.*, 1945, **38**, No. 1, 125-126. Describes tests carried out against the harlequin bug, the green clover worm, Mexican bean beetle and German cockroach.

BOOK REVIEWS

Books for review should be addressed to "The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

WHITHER PLASTICS? H. Ronald Fleck, M.Sc., F.R.I.C. Pp. xxxiii + 99, 8½ × 5½. (London: Temple Press Ltd., 1944.) Price 15*s*.

At the commencement of his Introduction the author states that the purpose of the book is "twofold; to remove prejudice and misconception in the minds of the public regarding plastics and to attempt to delineate the position which plastics will occupy in the post-war era." It may be said at once that he has succeeded, and any misconceptions regarding the uses and potentialities of plastics previously held by the reader should be very largely clarified after a perusal of the contents of the publication.

In addition to the Introduction, the book is divided into fourteen chapters, the first dealing generally with the raw materials required and the manufacture of plastics, and the last being a brief summary of the possibilities and limitations of plastics, and the conclusions to be drawn. The other twelve chapters deal separately with various industries in which plastics are employed or may be employed in the future, viz., the electrical industry; building and architecture; the paint industry; glues and adhesives; the textile industry; the rubber Industry; the motor cycle and motor car industries; the aircraft industry; the engineering and transport industries; the chemical industry; surgery and medicine; art.

The subject matter is efficiently covered, as far as this is possible in so few pages, and the book provides an excellent survey of the present position of plastics in the various industries concerned, and the author's views on the extent and direction of any development that may be expected in the future. He is careful throughout to indicate the defects as well as the advantages of plastics in the industries reviewed and deprecates the exaggerated claims made in certain quarters.

The work is refreshingly free from misprints, but the statement that natural rubber is obtained from *Hevea latex* (on pp. 52 and 58) should be corrected in future editions. This should, of course, be *Hevea braziliensis*; also the name guayule (for the Mexican shrub, *Parthenium argentatum*) should not appear in italics.

One further criticism arises from the fact that separate chapters have been devoted to the separate industries rather than the individual groups of plastics. This results in a considerable amount of repetition, inseparable from this particular form of treatment, which is a source of some irritation to the reader. As an example of this the repeated statement that Perspex is a polymerised methyl methacrylate resin may be given.

In spite of these minor imperfections the book can be confidently recommended to anyone interested to any degree in plastics.

H. T. I.

THE PROVISION OF ANIMAL FODDER IN TROPICAL AND SUB-TROPICAL COUNTRIES: Part I. Bulletin 31 of the Imperial Bureau of Pastures and Forage Crops. Pp. 84, 9¾ × 7¼. (Imperial Agricultural Bureaux, Central Sales Branch, Penglais, Aberystwyth, 1944.) Price 4s.

In recent years research on grassland management and fodder production in the tropics has been given much more attention than in the past. This increased prominence is ascribed to the development of mixed farming, the realisation of the value of grass as a means of preventing soil erosion and an endeavour to improve nutrition by a more extended use of animal products.

With a view to collecting information on all aspects of fodder production from natural grasslands or cultivated crops in the tropics, a number of the authorities and specialists concerned were approached. The contributions so far received have been assembled by the Imperial Bureau of Pastures and Forage Crops, Aberystwyth, and are published in this Bureau's Bulletin No. 31. The areas dealt with so far are West Indies, Hawaii, Fiji, Gold Coast, Nigeria, Anglo-Egyptian Sudan, Zanzibar, and Southern Rhodesia. In these reviews details are given relating to the species that are found in tropical grasslands or are cultivated for fodder. Most of the articles are concerned with the actual management of grazing areas and its relation to soil conservation, the number of head of stock per unit area and the density of the population. From these contributions it is gleaned that the two most important questions in those districts where distinct wet and dry seasons occur are the reduction of stocking rates to allow the vegetation cover to regenerate and the conservation of fodder for use during the dry seasons.

It is intended to publish as soon as available the remaining contributions to this survey. The complete information should assist materially the development of practices and programmes of research for the different climatic and economic conditions which occur.

G. T. B.

LEY FARMING IN SWEDEN : A FIELD DAY AT SVALÖF. Bulletin 33 of the Imperial Bureau of Pastures and Forage Crops. Pp. 44, 9½ × 7¼. (Imperial Agricultural Bureaux, Central Sales Branch, Penglais, Aberystwyth, 1945.) Price 3*s.*

This Bulletin is an abridged English edition authorised by the Director of the Swedish Seed Association of a series of papers read at a Field Day devoted to ley farming, held at Svalöf in June 1943. The original Swedish versions of these papers were published in *Sveriges Utsadesförenings Tidskrift*, 1943, Vol. 53, No. 5.

The first paper in this collection reviews the fodder situation in Sweden and shows the extent to which that country depends on the products of ley farming. Two papers deal with the results of trials with different strains of red clover carried out in the southernmost province and with similar experiments with timothy throughout Sweden. These indicate the importance of selecting those varieties which are best adapted to the latitude in which they are grown. In a fourth contribution is discussed a problem which is receiving attention in other countries in the world, namely, the causes of the seasonal variation in the growth of pastures during critical periods in the summer. The factors chiefly dealt with were the effect of management, the type of manuring, rainfall and the height of the water table on the extent of the midsummer depression.

Two papers have a special bearing upon milk. In one of these is described the nature of the research work being carried out under the auspices of the Nordiske Jordbrugsforskeres Forening on forage plants, and their content of carotene. A high carotene content in forage plants is important, as this leads to a high vitamin A content in the animal products, particularly in milk and eggs. The second of these two papers is devoted to a consideration of problems relating to the effect of ley fodder on the taste and aroma of milk and on its butter- and cheese-making properties.

Another contribution describes experiments in fodder conservation. This subject was further discussed at a later Field Day at Svalöf and more attention will be paid to it in a later publication from the Pasture Bureau.

The final article deals with sugar beet as a fodder producer, and the conclusion is drawn that only when the tops are harvested in the most careful manner does sugar beet equal the better strains of fodder beet and mangolds. Although this paper was not presented at the Field Day and is not directly concerned with leys, it is referred to in this Bulletin of the Pasture Bureau because it was published in the same issue of the Swedish scientific journal, as were the other papers.

G. T. B.

SHEEP. By J. F. H. Thomas. Pp. 196, 8½ × 5½. (London: Faber and Faber Limited, 1945.) Price 15s.

Here is a book of specialist knowledge, of such general interest and so pleasing to read, that it will have an appeal to the layman as well as to those technically interested in the various subjects which are included under the brief term—Sheep. The range is wide, from sheep breeding and farming to the production of mutton, lamb and wool. Every aspect of sheep husbandry is covered, including: Breeds and Crossbreeds, Sheep Farming Systems, Flock Management, Prevention and Control of Disease, Specialist Sheep Farming of Scotland, Wales and the Scottish Border Counties, and suggestions are made for the future development of the sheep industry in Great Britain. The marketing of sheep products is also dealt with. The chapter on the importance of sheep in British farming is of great interest and importance, and treats of a subject which has always been controversial.

As the sheep industry is widespread in these islands, and of highly localised character, the author has wisely called on regional experts to assist him. Martin Jones, M.Sc., has written the chapter on Mountain and Hill Sheep Farming in Scotland, A. R. Wannop the chapter on Sheep Farming in the Scottish Border Counties, and Moses Griffith, M.Sc., has dealt with the subject in respect of Wales.

There are in the book 44 photographic illustrations, which are excellently produced, and which are very necessary when writing about animal breeds and their management. There is also an Appendix giving a list of Sheep Breed Societies, with their secretaries and addresses. In conclusion it may be added that the extensive field of information has been covered in 196 pages in an effective and attractive manner, on which the author is to be congratulated.

J. R. F.

MINERAL RESOURCES

ARTICLE

MICA, BERYL AND COLUMBITE-TANTALITE IN RAJPUTANA

By H. CROOKSHANK, B.A., B.A.I., D.Sc.,
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GEOLOGY

PEGMATITES occur in Rajputana from the Gangetic alluvium about Delhi and Agra to the plains of Khandesh and from the great Vindhyan Scarp to the Sindh desert. Some of them occur as low hills or ridges in open cultivated country. Others are not exposed at the surface, but have been discovered by cultivators who have ploughed up mica or quartz and subsequently put down prospecting pits. They vary in size from large masses 500 yds. long and 50 yds. wide to mere stringers, and may be of almost any shape from long narrow dykes to quite irregular masses. Most of them are vertical or dip steeply, but where the schists in which they occur have low dips the pegmatites are frequently flat sills. The general trend of the pegmatites is parallel to the strike of the schists, but in detail they cut across the schists freely and are certainly much younger than them.

Most of the pegmatites are found in schists, but they also occur in granites, quartzites, and crystalline limestones. Their presence is often related to the structures of the older rocks. Thus in the common case where large anticlines of quartzite are separated from cores of granite by a zone of schists and limestones, the pegmatites cluster in the schistose zone. Only a few small ones cut the quartzites or the granites. Beryl and columbite-tantalite appear to be commonest in the pegmatites on the margin of the granite. Mica associated with much beryl is usually green or inferior black-spotted. The good quality mica seems to be usually in pegmatites at some distance from granitic masses.

In areas where much mica and beryl occur in the pegmatites the metamorphism of the schists is generally medium grade. Where the metamorphism is low grade, the pegmatites are often barren.

Some mica-bearing pegmatites are just coarse-grained granitic masses with numerous inclusions of country rock and show little sign of differentiation. Others are differentiated and show a quartz core flanked by a zone of pink or white felspar which becomes increasingly micaceous towards the outer limits of the pegmatite. Inclusions of schist are common near the margins of the pegmatites. Green micas often occur about the central quartz core, but the more valuable ruby mica is commonly associated with inclusions or is marginal. It is most probable that much of the ruby mica is due to recrystallisation of mica from the surrounding schists in the body of the pegmatite. The green mica may be magmatic.

Beryl is found throughout pegmatites, but the large crystals which can be profitably extracted are most commonly met with along the margin of the quartz core either in the quartz or in the adjoining felspar. The cleavelandite variety of albite is a form of felspar which often occurs along with large beryl crystals. Columbite-tantalite has been found in many places closely associated with beryl but is a much rarer mineral.

MICA

The principal areas where mica has been worked during the war are Udaipur State, including a small outlier of Gwalior State, Jaipur State, Shahpura State, Ajmer-Merwara, and Tonk.

Udaipur.—Udaipur State is the most prolific mica field in Rajputana, and also produces half the beryl, and all the columbite-tantalite mined. The principal centre of the mica trade is Bhilwara on the B.B. and C.I. Railway some 700 miles from Bombay. In the low hilly country within 50 miles of this centre many rich mica-bearing pegmatites are known and have been worked on a small scale for a long time. It was not, however, till the 1914-1918 war that serious work was commenced in this area. At the end of the war the mines were closed and did not reopen till after 1930, when Messrs. Labchand & Duduwala obtained a lease to work mica over a large area. They undertook extensive prospecting, and proved well over 100 workable pegmatites. Following on this success two other companies obtained concessions for further large areas in the vicinity of Bhilwara, and further west. Their operations also proved successful, and at the beginning of the war there was already a large production of mica of rather poor quality in Udaipur. Much of this was sold to Germany and Japan.

After the outbreak of war with Japan there was no demand for the lower qualities of mica, and the companies working in Udaipur were forced to stop mining it, and to concentrate on the better qualities. At first this caused some falling off in production, but by the end of 1943 their output had recovered. The mica produced contained a useful percentage of the good stained and better qualities which were in particular demand for war purposes. The size of the mica was similar to that mined in Bihar. Actual details of quality were never obtainable because the greater part of the Udaipur production was dispatched by rail to Bihar for final dressing and sorting, and was mixed there with Bihar mica. Much of the mica was, in my opinion, of as good quality as that dispatched from Jaipur, for which approximate figures are available (see below).

The total annual production of Udaipur for the years 1943 and 1944 was about 17,000 cwt. of sickle-dressed block ruby mica and a small amount of black-spotted mica. Considering that the mica-bearing area in Udaipur is devoid of all metalled roads and rather thinly populated, this is a large production.

Jaipur.—Prospecting and mining of mica in Jaipur State has been going on for twenty years or more, but has only become firmly established in the last ten years. The Durbar has given concessions to two mining companies for the whole State. The Garnet and Mica Mining and Prospecting Syndicate has the lease of all non-Khalsa lands, while the Rajputana Mining Company of Jaipur, managed by Mr. Baini Prasad, holds the lease for the Khalsa lands. The former company, owned and managed by Messrs. Shri Bux and Shri Newas, has been extremely successful. Their principal mines are in the south and west of the State, but they also have mines at Torawati, and were prospecting in Kekri and Shekhawati in the northern part of the State. The mica from their principal mines is brought to Diggi to be dressed and sorted. This is done by experienced Bihari workers helped by local labour. During 1943, 1944 and part of 1945 their output was sold to the Joint Mica Mission in Bihar ready for export. Many of the consignments contained approximately:

Fair Stained, or better 4 per cent.
Good Stained, 20 per cent.
Stained, 50 per cent.
Heavily Stained, 14 per cent.
Densely Stained, 12 per cent.

The size of the mica dispatched was above average, though it did not contain as large a percentage of " Specials " as is found in some of the mines in Udaipur.

The production of the Rajputana Mining Company was also considerable, but the quality and size of the mica which they produced was disappointing. They were much hampered by water-logging of their mines and shortage of pumps. With experience and better pumping arrangements their production of good-quality mica is likely to improve.

The annual production in Jaipur for the years 1943 and 1944 is thought to have been about 4,500 cwt. of ruby mica. A considerable amount of black-spotted mica was also mined, but probably only a part of this was actually sold.

The mica-mining areas in Jaipur are reasonably well served by metalled roads, but most of the mines are scattered over a large area some 50 miles from the nearest railway.

Shahpura.—The history of mica-mining in Shahpura State is not known, but some of the best mines had been worked for many years before they came into the hands of the present lessee. The mica-mining lease for the State is now held by Messrs. Pusalal Mansinghka, a firm which is working the area with vigour and determination. Most of the mica in the State is black-spotted, but in spite of this it is popular with the buyers because it is hard, flat, and large in size. A few mines produce ruby mica, and one of these formerly had the reputation of producing the best quality mica in Rajputana. Unfortunately this mine has been extensively worked in the past, and it is doubtful whether it will continue to yield a large output in the future.

The production of sickle-dressed block mica in Shahpura State in 1943 and 1944 is believed to have been about 3,000 cwt. annually, half of which was ruby and half black-spotted. The production was increasing, and would be much greater if there were a good demand for black-spotted mica.

Shahpura is a small State in rather flat country lying between Ajmer-Merwara and Udaipur. Its communications are unmetalled cart tracks leading to a railway station some 16 miles distant from Shahpura city. During the rains communications are difficult but during the rest of the year they are easy.

Ajmer-Merwara.—Mica has been mined intermittently by the Banjaras in Ajmer-Merwara for a very long time. The first mining on an extensive scale was, however, undertaken in Nazirabad by Europeans during the 1914-1918 war. They concentrated on large black-spotted mica, and were unable to continue mining operations after the war when sufficient ruby mica to meet the world's demands became available in Bihar.

After the collapse of the war demand, mica-mining ceased entirely until the thirties, when revival of interest led to the opening up of mines in many parts of Ajmer-Merwara. At the beginning of the 1939-1945 war, mining in this region was flourishing. The greater part of the production was still black-spotted, for sale to the Axis countries, but there was also a useful output of ruby mica from Beawar and Kekri.

With the entry of Japan into the war, the major outlet for the lower qualities of mica was closed, and the production, which was large up to 1942, was severely curtailed. The production of ruby mica kept up fairly well, but it was probably not so high at the end of the war as it was at the beginning.

Unlike the States which lease large areas to single mining companies, Ajmer-Merwara has given mining leases to some 50 contractors. In spite of this, its production in the latter years of the war was only about 3,000 cwt. of sickle-dressed ruby mica, and a small amount of black-spotted.

There are three main mining areas in Ajmer-Merwara—Beawar, Nazirabad, and Kekri. Beawar mica is ruby of good quality but rather small. Many of the better mines have been worked to a depth at which much pumping has become necessary, and therefore, owing to shortage of pumps and fuel, some of them could only be worked on a small scale during the war. There was also a very great shortage of labour owing to extensive recruiting in this area. The production was in the neighbourhood of 1,000 cwt. annually for the years 1943 and 1944. Nazirabad is the centre for mining black-spotted mica, but a few mines, belonging to Mr. Abdul Ghani, produce a small percentage of very nice, flat, ruby mica as well as the black-spotted. The production was very small during the years 1943 and 1944, but it is capable of rapid increase if a demand for black-spotted mica arises.

Kekri produces a mixture of ruby and black-spotted mica. On the whole the quality is not very high but the mines are prolific. The production was probably about 2,000 cwt. annually during 1943 and 1944. A good deal of the black-spotted was probably not sold after Japan entered the war. Production here would rise rapidly if there were a demand for black-spotted and other low-grade micas.

Communications in Ajmer-Merwara are good in the Beawar and Nazirabad areas, but rather difficult in Kekri, where the mines are over 50 miles from the railway.

Tonk.—Tonk State contains numerous large deposits of good-quality ruby mica of rather poor size. These deposits lie in open country north of the Banas River, within a few miles of Tonk city. They are all at no great distance from a metalled road and railway, but in spite of these communications it was only possible to produce about 1,000 cwt. a year in 1943 and 1944. This relatively low production was due partly to flooding and pumping difficulties, and partly to shortage of labour. The owner of the mica-mining lease also held important mica-mining concessions in Udaipur, and perhaps because these concessions were remote from Tonk and absorbed the lessee's main effort, that area was never worked as vigorously as the quality of Tonk mica justified. It should be possible greatly to increase the production of this region, when labour and mining machinery become freely available once more.

Other areas in Rajputana. Mica was worked during the war were Dungarpur, Idar, Jodhpur, Kishangarh, Alwar, Bharatpur and Patiala. All of these States contain mica-bearing pegmatites, but none of them have so far proved to be substantial producers of good ruby mica. It is quite possible that some of them may ultimately become producers of importance. I do not think, however, that any of them are likely to develop into great mica fields.

Rajputana ruby mica does not normally contain as much of the higher grades of mica as are customary in the Bihar material. Its worst defects are buckle and waviness. In thick plates it appears to be browner than the best Bihar ruby, and experts claim that they can always tell which is which by the colour, but I very much doubt whether this is possible with thin plates. The average size of Rajputana mica is about the same as that of Bihar. Some areas like Beawar and Tonk produce a large percentage of No. 7. If this were in better demand it would greatly assist the industry. The costs of mining mica in the better mines throughout Rajputana are believed to be much lower than in the older and deeper mines of Bihar. On the other hand the Bihar mica is more valuable. Whether this compensated the Bihar miners for their higher mining costs during the war it is impossible to say. It is, however, a fact that Rajputana greatly increased her production of the better quality micas during the war, whereas the production of Bihar tended to fall. She should be well placed to meet any post-war demand for the cheaper qualities of mica for reconstruction purposes.

Rajputana, mica-mining is considerably handicapped by the inability of the workers in this region to sort and dress the mica to Bihar standards. Successful efforts to remedy this state of affairs were made by Messrs. The Garnet and Mica Mining Syndicate of Jaipur. Messrs. Duduwala of Bhilwara have also done a great deal to improve their mica factory. In general, however, Rajputana is unable to produce mica properly dressed and sorted for export. Until the Rajputana mica producers succeed in doing this they are bound to be at the mercy of the Bihar buyers.

The increase in production of good-quality mica in Rajputana was effected in the face of every possible obstacle. Labour was scarce, dear, and inefficient. Mining machinery was almost unobtainable. Fuel was scarce and dear. Tools and explosives were short, and transport of all kinds difficult. In view of the difficulties which the Rajputana miners successfully overcame in war-time, it would not be surprising if they greatly increase their production as soon as mining conditions become easier.

One of the more important causes of the Rajputana miners' difficulties was the policy of the Joint Mica Mission. This diverted all available machinery to Bihar on the grounds that the quality of the mica there was the best in India and that, therefore, everything possible must be done to stimulate its production. Under the circumstances this policy was understandable, but whether it was successful in getting the maximum amount of high-grade mica for war purposes is open to doubt. It certainly enabled the mission to obtain much high-grade mica without having to buy too much of the lower grades which were not immediately needed for war purposes, but it is considered likely that the diversion of much of the machinery supplied to the poorer mines in Bihar to assist the best of the mines in Rajputana would have produced even better results.

As the result of the shortage of all forms of mining machinery during the war, the mine-owners in Rajputana were obliged to use mining methods even more primitive than those in use in Bihar. If the industry is to become a permanent one, it will be necessary to improve the mining technique as soon as possible. This should not be difficult, as the bulk of the mica production is in the hands of a few wealthy owners, who can well afford to sink a little capital in their mines. Uncertainty as to the future market for mica may, however, delay the long overdue modernisation.

Theft of mica is a very serious problem in Bihar. It reduces the profits of many of the mining companies, and acts as a serious deterrent to enterprise. Owing to most of the Rajputana mica being in the hands of rich firms, and to the scattered nature of the mica field, mica theft has so far not been very serious there. If this ugly traffic can be successfully controlled, it should help to establish mica mining in Rajputana on a permanent profitable basis.

BERYL

After mica, beryl was the most important pegmatite mineral produced in Rajputana for war purposes. The main production was in the hands of Messrs. Fateh Ali of Bombay, Abdul Ghani of Nazirabad, and Wahid Nur Khan of Bhilwara, but a large number of small producers helped to increase the amount of beryl dispatched from Rajputana to America. Nearly all the beryl produced was bought by Messrs. Fateh Ali of Bombay and dispatched by sea to its destination after sorting, analysis and packing in suitable containers.

Although beryl has been reported in pegmatites from many areas in Rajputana the principal production was in Bhilwara and Ajmer-Merwara. At first it was mainly found loose in the debris from pegmatites or extracted from the dumps and walls of old mica mines, but later the bulk of it was obtained by quarrying in a comparatively few areas. The total production for 1943 and 1944 is believed to have exceeded 1,000 tons per annum of ore, running about 12 per cent. BeO, but it is not considered likely that production on such a scale could continue for long at present prices. Pegmatites with more than 2 per cent. beryl are rare. If it were economic to mine for beryl in pegmatites as poor as this, a price more in the neighbourhood of £100 a ton would be necessary to attract capital. Admittedly some of the operators made handsome profits at the price of $9 a unit offered by America, but they were working on easily-won surface material and had not the expense of mining such a precarious mineral.

Experience showed that to make a profit out of beryl it was necessary to find large beryl crystals, preferably of the order of 1 ton or more. When those exposed at the surface were worked out, few of the miners had the courage to break fresh ground in the hope of finding more below. Whether crystals of this kind continue in depth was never proved. The Tihari mine some 20 miles west of Bhilwara has been worked for several years, and was still yielding large crystals, though far fewer than at the surface. Another at Bisundni in Ajmer-Merwara had been worked on and off for ten years and still was yielding fair results. In this mine it was fairly easy to follow the beryl, as all the larger crystals were found at the junction of the felspar with the quartz core. Another mine about 15 miles west of Ajmer provided several hundred tons of surface beryl, but the owner rapidly gave it up when he had to start quarrying, on the ground that it did not pay. This was a huge quartz pegmatite, which had penetrated crystalline limestone, and contained numerous inclusions of calcite.

It is a mistake to suppose that large amounts of beryl can be obtained as a by-product of mica mining. Probably not more than 10 per cent. of the total beryl produced was derived from mica mines or old dumps. Generally speaking, mica miners do not think it worth their while extracting the beryl from their mica mines, and only did so as a concession, because it was urgently required for war purposes.

COLUMBITE-TANTALITE

Columbite-tantalite occurs, associated with beryl, in a number of pegmatites some 20 miles west of Bhilwara, and also about Ajmer and Kekri. Mr. Wahid Nur Khan opened up a number of pegmatites in the first-mentioned area in the hope of finding the mineral in workable quantities. He was disappointed in this and had to stop working all the mines which he had opened up except one or two where beryl was found in workable amounts. In the end he only worked columbite-tantalite as a by-product of his beryl mining. About 10,000 lb. in all were produced in 1943 and 1944. Some of the mines yielded ore containing 30 per cent. Ta_2O_5 which could be sold for its tantalite content. In other mines the mineral was sold for its columbite content. At ruling prices the mineral could only be produced at a loss, but enough was won to justify the conviction, that if the price of columbite-tantalite were sufficiently high, a small regular production would be possible.

No effort was made to work the mineral near Ajmer, but, as a matter of interest, a pit was opened up where nodules of columbite-tantalite intergrown with beryl were discovered, and a number of very interesting nodular intergrowths of columbite-tantalite with quartz, felspar and beryl were obtained.

ABSTRACTS AND NOTES

Geological Survey of Nigeria.—The following note on the geological and mineralogical investigations carried out in his Department during 1944 has been received from Dr. F. Dixey, O.B.E., who took up his duties as Director of the Geological Survey of Nigeria in July 1944.

Columbite-tantalite.—As the result of the sudden demand for tantalite, the attention of the Geological Survey during the year 1944 was mainly directed to the pegmatites of Central Nigeria which are the source of this ore. The investigation included a comprehensive field and laboratory examination of the pegmatites over a wide area with particular emphasis on the tin and columbium-tantalum mineralisation. A preliminary account of this work was published in the Annual Report for 1943. The final report is in course of preparation.

In order to clear up the relationship of the pegmatites to the general geology, mapping of the Isanlu Quarter Sheet in Kabba Province was commenced on a scale of 1 : 125,000.

Plateau Tinfields.—Late in the year, a detailed investigation of the alluvial tin-deposits on the Nigerian plateau was commenced; these deposits form the main source of Nigerian tin and columbite. The present investigation, which is expected to take several years to complete, includes a revision of the mapping of the Fluvio-volcanic Series and the Newer Basalts, and a detailed study of the buried tin leads. The existing geological map on a scale of 1 : 125,000 was published in 1921 and since then little work has been done. The present mapping is being carried out on a scale of 1 : 25,000, and was begun in the Werran Hills area. The mining companies, who are particularly interested in the investigation, are co-operating by supplying all the information at their disposal in connection with tin leads which have been worked and prospected. It is hoped that these investigations will be of considerable assistance in the future development of alluvial mining on the Plateau.

Laboratory Work.—A considerable amount of mineral investigation was carried out by the Geological Survey laboratory under the supervision of a mineralogist. In the course of the year some hundreds of tin, columbite-tantalite and other concentrates were examined for the mining community and in connection with the Departmental work.

Water Supply.—During 1944 only three European officers were available for well-sinking work out of the pre-war total of eleven, and activities were accordingly much reduced. Thirteen open wells were successfully completed in Sokoto Province, 31 in Katsina Province, 27 in Kano Province, and 23 in the Sleeping Sickness Settlement area of Zaria Province. In addition, thirty-five old wells, mainly in Sokoto Province, were repaired. A small amount of work was done in Bornu, and some trial shafts were started at Minna. Many earlier wells were provided with concrete aprons and drains.

Modifications in well-sinking technique were temporarily adopted where adequate supplies of steel were difficult to obtain, and in accordance with this plan the reinforcement in the concrete lining of certain wells in the crystalline areas of Katsina Province was much reduced.

A second bore-hole in Maiduguri, begun in March, had reached a depth of 90 ft. when the Drilling Superintendent went on leave.

A comprehensive scheme of rural water development, under the Colonial Development and Welfare Fund, has been approved, and it is proposed to commence this work early in 1945.

Report of the Committee on Deep Level Mining in South Africa.—Among the principal problems with which the gold mining industry of the Rand is faced are not only the extent to which the auriferous deposits persist in depth, but whether it will be possible to mine to much greater depth. The report of the Committee appointed by the Union Minister of Mines has recently been published under the above title by the Government Printer, Pretoria (1945, 9 pp., price 2*s*. 6*d*.). This important document is intended mainly to inform the Government and to advise it regarding the steps it should take. It is commendably brief and to the point, and it is shorn of technicalities as far as possible.

By October 1944, seven of the Witwatersrand mines had reached a vertical depth of about 8,000 ft., and three of these had reached 8,500-8,700 ft. Increasing depth has led to a variety of difficulties. Deeper shafts have had to be sunk, and existing shafts deepened. Ore, waste rock and materials, as well as water, have had to be brought to the surface by hoisting or pumping from these ever increasing depths. Rock temperatures and air temperatures have risen so high that human endurance has been strained to its limit, and there have been deaths from heatstroke. Rock pressure has increased to such an extent that it is becoming increasingly difficult to control.

These difficulties inevitably involve increased capital outlay and working costs. There is also a tendency for the grade of ore to fall with greater depth; that is, for the revenue per ton of ore won to decrease. Falling revenue and rising costs ultimately result in the disappearance of profits and, when that stage is reached, mining operations become uneconomic and must necessarily cease. Advances in ventilation and mining technique have enabled depths to be reached in excess of the limit placed on mining operations not many years ago. Nevertheless, the report points out that it now seems clear that without further great improvement we are very near the final limit that can be reached in South Africa under existing circumstances and with present-day methods. Indeed, the general concensus of opinion is that the maximum depth at which mining can be carried on profitably is about 9,000 ft., and that, in any case, even with further improvements in technique and practice, it will not exceed 10,000 ft.

As to the probability of extending profitable operations to greater depth than hitherto, it is concluded that, whilst technical progress has successfully met the problem of increasing rock pressures, the main difficulties are going to be due to temperature and ventilation. The system of wet mining, necessitated by the need to prevent the formation of large quantities of silicosis-producing dust, is a tremendous handicap to the attainment of cooler working places and sets the limit of depth. It is not beyond the bounds of possibility that a method of dry mining may be evolved on the Witwatersrand that would involve no more danger from silicosis than the present wet mining system, and with the knowledge of what is already being done at greater depths and much higher temperatures in the Kolar goldfield of Mysore (where the silicosis hazard is not such as to necessitate wet mining) it is hoped that ultimately mining may be carried to a vertical depth considerably greater than the present limit on the Witwatersrand.

It is extremely difficult to make any reliable estimates of the amount of deep level ore in the stretch of 30 miles from Roodepoort to the East Rand Proprietary Mines. On the assumption that only one-third of the area contains payable reef, that the dip is 30°, that there is only one payable reef, and that the average width is 4 ft., there emerges a figure of 35,000,000 tons for every 1,000 ft. of vertical depth. If the average grade were 32/- per ton, which is the average of the mines now working in this area, the gold yield would be £56,000,000 for every 1,000 ft. of depth or, in round figures, £200,000,000 to a depth of 12,000 ft.

There follows a discussion of the technical and financial difficulties which militate against the extension of mining to greater depths. It is disclosed that if a new mine had to be started to deal only with the deep level area, i.e. at a depth greater than 8,500 ft., the capital cost of shaft sinking and equipment would be £8,715,000 for a mining area containing 25,000,000 tons of payable ore. The conclusion arrived at is that such a proposition is financially unattractive and that the Central Witwatersrand offers no justification for the starting of such new mines.

The Committee conclude that on the Central Witwatersrand the Government should not encourage the opening up of new mines to exploit the deep level ground, but should, as far as possible, assist the existing mines to work to the greatest possible depth and to proceed by way of gradual evolution. It has been estimated that, apart from taxation, the State Revenue benefits indirectly to the extent of 6s. 8*d*. for every ton of gold ore mined ; the desirability of working as much of the potential reserves as possible is therefore obvious. With good ventilation, the present system of wet mining, possibly with some modification and with the aid of refrigeration, may be carried to 10,000 ft., but greater depths will require the adoption of dry mining. The two important issues which arise are the feasibility of dry mining, and whether the provision of the necessary capital for shaft sinking, equipment, etc., that will be required for the extension of mining to the greater depths is justified.

The immediate institution of vigorous research on these problems is recommended, and to this end the appointment of a committee of experts and the setting up of a Rand Mining Research Institute with a financial provision of £30,000 in the first year are proposed. The investigations, the report states, should be prosecuted with the utmost vigour and should not be delayed at any time for want of funds or for any other reason.

A. W. G.

Blue Asbestos in Western Australia.—Although the existence of blue amphibole asbestos (crocidolite) in the north-western part of Western Australia was reported a quarter of a century ago, it was only in 1929 that the occurrences were authenticated when the late Dr. E. S. Simpson published a short description of the crocidolite from Mt. Margaret and Willi Wolli Springs. Subsequently they were reported upon in more detail, and as a result of recent increased interest in these deposits, the Geological Survey decided to publish the existing data as Bulletin No. 100 (Pt. I, "The Blue Asbestos Bearing Banded Iron Formations of the Hamersley Ranges, Western Australia," by K. R. Miles; Pt. II, "The Blue Asbestos Deposits of the Hamersley Range and their Economic Importance," by J. S. Foxall; with appendices: *Geological Survey, Western Australia*, 1942.)

It is pointed out in these reports that the quality of the material was established just before the war when parcels of high-grade fibre realised up to £75 sterling per ton in London. Unfortunately, however, this news led to a "rush" to the area and resulted in primitive and unsystematic working with uncontrolled output and unsound economic conditions. Overproduction and excessive supply caused the local agents of British, American and Japanese firms to stop buying, so that actual distress resulted, and all but one or two producers ceased operations.

The Hamersley "ranges" are really a dissected plateau, and they consist in general of horizontal or gently warped banded ironstones or ferruginous cherts, quartzites, shales and thin bedded dolomites, all forming part of the Nullagine Series (? pre-Cambrian). Exposures of the asbestos-bearing horizons are found in the deep gorges and cliff faces carved by tributaries of the Fortescue River.

Needle riebeckite, mass fibre riebeckite (" potential crocidolite ") and cross-fibre riebeckite (crocidolite proper) all occur in the Hamersley field, with marked geological similarity to the South African crocidolite which also occurs in banded ironstones. A previous report by an officer of the Survey gave the opinion that the Western Australian deposits contain a greater proportion of long fibre (+1½ in.) than do the South African blue asbestos deposits. It is stated that the Canadian system of grading asbestos is not entirely suited to Australian blue asbestos, so that it is suggested that some standard code will have to be evolved and adopted as the industry grows. The fibre length of the Hamersley asbestos of commercial quality ranges from less than 1 mm. to about 50 mm. There is exceptional uniformity in the parallel cross-fibre habit, but again, as in the South African deposits, cone and corrugation structures are known to occur. The riebeckite-crocidolite is believed to have originated by the recrystallisation and growth *in situ* of material originally present in the banded ironstone, under conditions of mild load metamorphism.

In view of the potential economic importance of these deposits, the following analyses, published by the late Dr. E. S. Simpson, are given in comparison with those of other blue asbestos and similar amphiboles from South Africa, India and Siberia.

CHEMICAL ANALYSES OF CROCIDOLITE AND ALLIED AMPHIBOLES

	1.	2.	3.	4.	5.	6.
SiO_2	51·86	51·94	51·04	50·50	54·48	54·01
Al_2O_3	0·03	0·24	0·20	–	2·10	0·23
Fe_2O_3	20·26	18·93	18·64	20·20	15·79	15·70
FeO	14·84	15·25	19·39	15·40	5·02	0·42
MnO	0·01	0·01	–	–	0·08	0·14
MgO	3·26	3·94	1·37	3·65	12·11	10·01
CaO	0·49	0·40	0·19	0·80	1·04	1·52
Na_2O	6·12	6·00	6·07	4·40	0·34	0·22
K_2O	0·28	0·26	0·04	–	0·32	0·35
H_2O+	1·97	2·67	2·58	4·15	0·40	2·25
H_2O-	0·68	0·72	0·31	1·05	-	–
TiO_2	0·03	0·01	—	—	nil	trace
CO_2	0·02	nil	—	–	–	—
P_2O_5	0·05	nil	—	–	trace	—
Cr_2O_3	nil	nil	—	–	—	–
	99·90	100·37	100·73	100·15	98·31*	99·85
Sp. Gr.	3·31	3·27	—	—	3·18	3·12

* Including 0·63 per cent. residue insoluble in HF and H_2SO_4.

1. Crocidolite from three miles west of Mt. Margaret, Hamersley Range.
2. Crocidolite from eight miles south-east of Willi Wolli Springs, Hamersley Range.
3. Fine blue fibrous Crocidolite from Kliphuis, eight miles north of Prieska, Griqualand West, South Africa.
4. Crocidolite from Kuruman, Bechuanaland, South Africa.
5. Bababudanite from Bababudan Hills, Mysore, India.
6. Rhodusite from Siberia.

In chemical composition, form, structure and optical properties, the Western Australian material is very closely similar to that from South Africa. As with blue asbestos from other sources, it is better than chrysotile in tensile strength, in electrical insulating value, and particularly in resistance to attack by acids, alkalis and sea water. The suggestion is put forward that there are numerous uses of asbestos in which crocidolite could be used instead of chrysotile. Apart from the question of exports, this would be of importance, for the Commonwealth imports very considerable quantities of asbestos of all types. In 1940, for example, imports of asbestos were reported as 281,944 cwt., valued at £321,832 sterling or £402,290 Australian. This works out at an average of £25 10s. 0*d*. Australian per short ton, and indicates that a good deal of the total was short-fibre asbestos. No statistics, however, are available to show the amount of blue asbestos imported into the continent.

The asbestos-bearing belt is believed to extend over a distance of some 120 miles in an east-west direction and up to about 4 miles in width, and within this zone considerable amounts of asbestos could be recovered by open-cast methods, though this should only be a preliminary to large-scale underground operations. No estimate of the total tonnages available can be made at present, as much more topographical and geological survey work is required for this purpose.

The climate of the area is very pleasant in winter, but rather trying in summer, so that provision of adequate living conditions would have to be made. Transport in the area is on roads of fair quality, and transport costs to the coast, which is on the average 200 miles distant, range from £6 to £8 per ton.

The Geological Survey concludes that there is a possibility of developing a very profitable industry based on this asbestos and that eventually the area could become one of the chief asbestos centres of the world, although proper organisation, technical facilities and finance would be necessary to bring this about. Only one company with a plant, and one private operator using primitive methods, were in operation at the time the area was visited by the Survey.

E. R. V.

The Search for Oil in South Australia.—This is the title of Bulletin No. 22 (1944), of the Geological Survey of South Australia, by Dr. L. Keith Ward, former Government Geologist and Director of Mines, and now consultant to the Government. The report covers the whole field of oil search in South Australia, both from the scientific and commercial aspects, and also provides a complete record of the many unsuccessful attempts made to find oil.

In his introduction, the author states that the report has been written with the object of placing the search for oil in South Australia on a better basis as it cannot be claimed that the history of much of the work already carried out is creditable. There is more than one reason for the lack of success, but none, he says, so far-reaching as the readiness with which credence has been accorded to the self-styled expert who has given the assurance that, by taking his advice, a little expenditure on perhaps the drilling of a single borehole will suffice to tap a large amount of petroleum. Apart from the operations of individuals, the search for petroleum in South Australia since the beginning of the second decade of this century has been conducted by at least 17 companies and syndicates, the affairs of which have been controlled by persons who have had no qualifications that would fit them to form sound decisions about the many technical problems involved in the search in all its stages. A plea is made for the employment of experienced men, trained in geology, in administrative and managerial control of operations connected with oil exploration and production.

Although more than £200,000 has been expended on the search for oil in this State the results have been negligible, and there is not even a full and detailed record of the drilling—information that might well have been valuable in the guidance of future work. Fortunately the provisions of recent legislation will remedy this latter deficiency when any future drilling is undertaken.

For the guidance of future work, the author gives an admirable, yet concise, review of the present state of knowledge concerning the occurrence of petroleum. He examines the reasons for the belief in the existence of petroleum in South Australia, dispelling many popularly but erroneously held views as to what constitutes such evidence.

The bulk of the report is devoted to a detailed account of oil prospecting operations in South Australia. Much of the story is certainly not a creditable one, and it is remarkable that so many people have been prepared to put their money at the disposal of diviners and unqualified persons; still worse is the lack, or sometimes falsification, of the results of this worst form of wildcatting.

After reviewing the stratigraphy of South Australia with special reference to the possibility of finding oil, Dr. Keith Ward points out that attention is naturally focussed upon the Tertiary rocks of the south-eastern region, and especially upon the area lying to the south of the Naracoorte-Kingston railway. Several boreholes, some of them fairly deep, have been drilled in this area with negative results, but the detailed examination of the country has been restricted to a very small area near Burnda. No adequate regional survey has yet been carried out, and the reasons for the selection of some of the bore sites are obscure.

He concludes: "It is difficult to understand why, if oil exists in the region, some sign of it has not been seen at any of the volcanic vents or along the course of Tartwaup fault. There is some difficulty also in concluding that the accumulation of oil is possible in a region through which there is such a copious and active movement of underground water towards the sea. Traps in which oil might be stored for long periods, despite active water circulation in the region generally, can be pictured in the imagination, but their existence is not known at the present time. Before any further expenditure on drilling in this region is incurred, there should be carried out a systematic aerial photographic survey in the first place, followed by a detailed geological survey. When this preliminary examination has been made, and not until then, is it time to form a judgement as to the quantitative nature of the risks involved in an exploratory drilling campaign."

The report ends with a synopsis of the South Australia Mining (Petroleum) Act, 1940, together with reasons for the principal provisions. The object of this legislation, it is stressed, is to make the search for oil in South Australia attractive to interests possessed of full knowledge of modern technique in all its stages. Any reluctance that such interests may have felt in the past to enter this State should be dispelled by the legislation which makes it possible for the acquisition of sound titles over continuous areas large enough to enable a thorough test to be made of any structures favourable to the occurrence of oil, where such structures may be found to exist. When peace is restored it is expected that all parts of the Australian continent will be given the serious attention of oil prospecting companies.

A. W. G.

The Search for Oil in British Guiana.—The Central Mining and Investment Corporation, Ltd., with which was associated Trinidad Leaseholds, Ltd., applied in June 1938 for an oil exploration and prospecting licence over a section of the coastal belt of British Guiana, namely, from Punta Playa to Moruka River, together with adjoining marine concessions out to the international limit. The concessions granted by the Government of British Guiana eventually reached 7,630 sq. miles. A detailed account, from which the following is abstracted, of the subsequent search for oil, which proved unsuccessful, is published under the title " Report on Exploration for Oil in British Guiana," by H. G. Kugler, S. C. Mackenzie, R. M. Stainforth, J. C. Griffiths and G. R. Brotherhood (*Geol. Surv. Br. Guiana, Bull.* No. 20, 1942 (1944); price 1$).

The first stage of exploration was to determine whether a sufficient thickness of sediments had been deposited on the old basement rocks. In October 1938, Professor V. C. Illing recommended a short refraction seismic survey. If this survey were to find the sediments to be not more than 2,000 ft. in thickness, then the prospect was to be abandoned. If, however, a satisfactory thickness of sediments were found, then this initial survey was to be followed by refraction profiles and by a reflection survey. Dr. Kugler visited the North-West District, and, after due enquiry in the field and in records, recommended a seismic survey of the Berbice basin, which was then agreed upon.

The seismic survey was carried out by the Seismograph Service Corporation between January 27 and November 15, 1939. The programme of operations had a threefold purpose :

(1) To ascertain the thickness of the sedimentary cover overlying the basement complex.
(2) To determine if well-bedded sediments exist between the unconsolidated quaternary sediments and the basement complex.
(3) To attempt the construction of contour maps of the subsurface.

The progress of the seismic survey, of which full details are given in the report, was continually directed by Professor Illing and Dr. Kugler until it was agreed that the information accumulated was sufficient to permit the location of a deep test at Rose Hall, near New Amsterdam, where a nose-like structure was found.

The estimate of the top of the basement complex at the well site was given by the Seismograph Service Corporation as 6,250-6,300 ft. The deeply weathered top of the basement was actually found in the test hole between 6,310 and 6,410 ft. If, however, the term basement is used from a geophysicist's point of view, namely, velocities of about 18,400 ft. per second, then the geophysical basement must be placed at about 6,420 ft. Considering the reconnaissance nature of the seismic survey, with its many unknown factors, it must be admitted, the report states, that the geophysical results were exceedingly satisfactory.

The great thickness of sediments and the presence of oil traps would themselves have been sufficiently encouraging, but the discovery of an intermediate high velocity bed appeared to afford real hopes for finding abutting Cretaceous beds, for it was in that age that shore line conditions existed along the northern slope of the Guayana Shield, and it was these conditions which resulted in the formation of the line of extensive oilfields directly above the basement complex of the southern rim of the Orinoco basin.

Whilst a maximum depth of 7,000 ft. for the basement appeared to be a reasonable assumption, to be on the safe side, drilling equipment with a depth capacity of 10,000 ft. was chosen. The well was spudded in on August 14, 1941, and completed at a depth of 6,456 ft. on November 30, 1941, i.e. in 109 days. Unfortunately it proved the intermediate high velocity bed to be a conglomerate at about 900 ft. above the basement. This discovery reduced to the minimum the chances of finding a Cretaceous overlap ; nevertheless, the well was continued to the basement, and, at least, showed an indication of heavy oil at 6,074 ft. On obtaining these negative results, the Central Mining and Investment Corporation, Ltd., relinquished the concession.

From the point of view of mineral resources, interest centres mainly on the discussion of oil indications and future prospects by Dr. H. G. Kugler, Chief Petroleum Geologist to the Central Mining and Investment Corporation. Although the oil prospects of British Guiana may be condemned, he points out that there is no explanation as yet for the presence of drops of inspissated oil or lumps of asphalt which have for many years been continually reported from different localities along the coast. He dismisses as impossible the theory of transport of asphalt by marine currents from the Orinoco delta or from Trinidad, as he also does the theory of exudation of oil formed *in situ* from swampy deposits.

A third theory, namely, origin from buried Tertiary rocks, Dr. Kugler considers can be applied only in a much wider sense than was done by those who considered it a likelihood. A considerable submarine extension in a south-easterly direction of the petroliferous Cretaceous and Tertiary sediments of Trinidad is known. " It would be expected that the steeply folded beds of Southern Trinidad would become more gentle as they approach the Guayana Shield.

They may be thrusted southwards along low angle-planes, but finally they must approach shore line characteristics similar to those of the southern rim of the Orinoco basin. Such conditions would exist far off the south-eastern tip of Trinidad and along a deeply submerged part of the Guayana Shield. The oil accumulated on structural lines would seep along faults caused or revived by orogenic movements and, similarly, as if under terrestrial conditions, would rise to the surface where the S.E. currents would carry the patches of heavy oil to the coast of British Guiana. Here, they could have been buried without change or could have hardened to asphalt. The spotty appearance of small quantities of heavy oil in the midst of coarse, freshwater-bearing sand, as observed during the drilling of artesian wells, would support this assumption and would also explain the show in the Rose Hall test well near the basement rock."

"Should the above assumption prove to be correct," writes Dr. Kugler in conclusion, "there would be a possibility of finding accumulations of oil off the northern shore line of British Guiana, possibly far out to sea, but still on the shallow shelf. It must be remembered, however, that the overlapping sediments such as Tertiary or Cretaceous are very likely of limited thickness and that they would have been exposed prior to burial under the younger infill of the Berbice formation. For this reason, heavy oil, similar to that of the most southern fields of Monagas in Venezuela, would be expected."

Mr. S. Bracewell, Director of the Geological Survey of British Guiana, in a preface, expresses his belief that when more is known of geological conditions in adjacent producing fields, attention will again be directed to the oil possibilities of the Guiana coastal belt, and that the present report will eventually serve as a reliable basis for further exploration of this nature.

The fullest details are given of the difficulties of getting the gear to the site, of the equipment and methods of drilling used, rate of progress, geological examination of the cores, petrographic work and Schlumberger tests, all illustrated by numerous charts and diagrams. In this respect the report, which we are told was not written with the original intention of publication, is nevertheless an excellent example of how such a complex technical report should be presented and will doubtless be studied by petroleum geologists and geophysicists as well as by those interested in the possibilities of oil in British Guiana.

A. W. G.

Mica Splitting.—The production of splittings from block mica has long been done by hand, and it is an art which has reached a high standard of proficiency, especially in India. Other countries, particularly those where wages are high, or where the mica industry is comparatively new, have indeed been handicapped both technically and commercially by the lack of local workers able to carry out this operation quickly and at a reasonable cost. It follows that the construction of two mica-splitting devices by D. W. Kessler of the U.S. National Bureau of Standards for producing films of thicknesses between one and three mils, may be of more than passing interest to mica producers in countries outside the United States.

According to an abstract in *Chemical Age* (1945, **53**, No. 1359, 28), Kessler states that these two devices were produced after investigations into various chemical and physical means of separating mica splittings had been tried without revealing any promise.

The first of these two devices consists of a single suction chuckplate which holds the mica blocks while it slides back and forth on a track. The gauge which starts the split is nearly stationary, there being only a slight rotation in a vertical plane. When a film is started and bent upwards, it is caught by two claws actuated by suction, and pressed on a small drum. As the drum rolls back, the film is stripped and carried to a suction belt which deposits it in a tray at some distance from the machine. This device produces about 30 films per minute, the slow rate being caused mainly by the fact that the operation has to be stopped while new blocks are being placed on the chuck. The method of stripping is also believed to be too severe since the bending of films causes more scales and defective sheets than does hand-splitting.

The second device consists of a disc carrying six chuckplates, a starter gauge similar to the first, two stripper blades and a suction belt for removing the films from the machine. With this device little time is lost in changing blocks, as one chuck is loaded by the operator while another block is being split. When the first block is finished, the operator turns the disc until the chuck comes into position, requiring only about one second for the change. With this device there is very little bending of the films, and the results are more satisfactory.

Although it is not categorically stated, it is manifest from these reports that the author himself does not consider these machines to be completely satisfactory either in efficiency or speed. Moreover, he does not state whether they are or would be a commercial proposition. Although, therefore, judgment upon them must be suspended, these machines make a definite advance, and any further developments will be awaited with interest.

E. R. V.

BOOK REVIEWS

Books for review should be addressed to " The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

STANDARD METHODS FOR TESTING PETROLEUM AND ITS PRODUCTS. Sixth Edition. Pp. xxxvii + 539, 8½ × 5½. (London: The Institute of Petroleum, 1945.) Price 15*s*.

The fifth edition of this book was reviewed in this BULLETIN, 1944, 42, 123, and the publication of a new edition, which includes a number of substantial additions and amendments, after the lapse of only one year, is an indication of the importance now attached to the standardisation of the testing of petroleum and related materials.

The size of the book has increased from 477 pages in the fifth edition to 539 in the present one, and its scope has been widened by the inclusion of methods for testing asphaltic bitumens and asphalts. Other new methods described deal with the determination of hydrogen sulphide in gases and distillates, mercaptan sulphur in light distillates, and total sulphur in gaseous and distillate products. A number of existing methods have been modified.

The appendix now contains a note on the principles governing oil measurement procedure, which has been drawn up in collaboration with the American Society for Testing Materials to establish a code acceptable in both the British Empire and the United States.

This book is indispensable to the petroleum technologist, who is fortunate in having his methods of testing so exactly defined.

W. H. B.

GEOLOGY OF QUEBEC: Volume II—DESCRIPTIVE GEOLOGY. Editors-in-chief: John A. Dresser and T. C. Denis. Geological Report 20, Department of Mines, Province of Quebec. Pp. xiv+554, 9¼ × 6¼. With Geological Map of Southern Quebec, in 3 sheets, scale 12 miles to 1 in.; Geological Map of Ungava: 41 figures, 45 plates. (Quebec: Redempti Paradis, the King's Printer, 1944.) Price $1.50.

This volume is the second in a series of three which together will constitute a comprehensive survey of the geology of the Province of Quebec. The first volume consisted of a bibliography and index to the geology of the province, and the third and final volume will deal with the economic geology, that is to say, with the mineral resources of the province.

The present part deals with the descriptive geology of the province, including topography, structure, stratigraphy, palaeontology, and petrology. From the very size of these subjects it will hardly be necessary to say that the volume is not an original work, but a compilation of the accumulated results of the large number of workers who have been studying the geology of this important area over the best part of a hundred years. Each aspect of the geology of the province is very adequately covered, particularly for the general reader, but for those who wish to go into more detail, there is a list at the end of each section of selected references to the more important papers from which the compilation has been made. It was to be expected from even a passing acquaintance with the geology of Canada, that each geological system in this area would not receive the same amount or intensity of treatment. The economic importance of the pre-Cambrian of Quebec, and indeed, of Canada as a whole, is such that the study of the more academic aspects of the geology of the province has also been biassed in favour of those areas where this system is encountered. Consequently, about one half of the book is devoted to the great area of pre-Cambrian strata which lies to the north of the St. Lawrence, the area known as the Laurentian Plateau Region. Ungava, or New Quebec, though also a very large area, is dealt with in quite a small section of this book, a significant pointer to the comparative lack of information which is available on this region.

A great deal is, of course, already known about the geology of the rest of Quebec, including the Gaspé peninsula, the islands, and the eastern townships, so that the authors have naturally devoted substantial sections in the present work to the geology of these regions.

Although, as stated above, this work is a compilation, the size and complexity of the subject matter is such that the condensation, digestion and presentation of the existing information is itself a task of some magnitude, and one calling for expert knowledge of the subject in hand. The authors and the editors, who incidentally have themselves made important contributions to our knowledge of this area, are to be congratulated therefore on giving us a very useful conspectus of the geology of Quebec. It will lay the logical foundation to the succeeding volume on the mineral resources of the area.

It would be unfair to conclude this review without drawing attention to the extent to which the work is illustrated. Geological maps, sketch maps, sections, photographs, plates of fossils and the like, are to be found throughout the volume in profusion.

E. R. V.

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PLANT AND ANIMAL PRODUCTS

REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the Reports made to the Dominion, Indian and Colonial Governments

MERANTI WOOD FROM MALAYA AS A SOURCE OF PAPER PULP

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The four samples which are the subject of this report were forwarded to the Imperial Institute by the Conservator of Forests in July 1938.

The materials consisted of poles representing young growth of four species of Meranti wood (*Shorea* spp.), which it was considered would become available in considerable quantities during the thinning of forest areas in Malaya. It was desired to learn whether such poles could be employed in the preparation of paper pulp and, in particular, of pulp suitable for the manufacture of kraft paper. The four species in question were as follows :

(1) *Shorea leprosula*, stated to be the most common species. A member of the " Red Meranti " group.
(2) *Shorea acuminata* } Two other members of the " Red Meranti "
(3) *Shorea parvifolia* } group, also occurring in fair quantities.
(4) *Shorea bracteolata*, a species belonging to the " White Meranti " group.

Description

The poles, which were about 4 ft. long, had been de-barked, air-dried, and brushed with 1 per cent. sodium arsenite solution prior to shipment. As growth-rings were not apparent it was not possible to record the age of the timber, but other particulars of the samples are given in the following table :

TABLE I

	Weight. *lb.*	Diameter. *in.*	Moisture. *Per cent.*	Density. *lb./cu. ft.*	Colour.
S. leprosula .	194½ (16 poles)	2·6 to 6·3 ; average 4·6	11·3	26·8	Pale buff sapwood, pinkish-brown heartwood.
S. acuminata .	55 (4 poles)	2·1 to 5·7 ; average 4·0	11·2	37·2	Pinkish-mauve.
S. parvifolia .	170 (17 poles)	2·1 to 6·8 average 4·2	10·8	28·8	Pale buff to greyish, with a slight pinkish mauve tinge.
S. bracteolata .	197 (15 poles)	2·1 to 6·7 average 4·4	11·0	30·7	Pale buff.

Results of Examination

Chemical Examination.—A representative portion of each sample of poles was finely ground, and the ash and cellulose contents estimated with the following results, which are expressed in each case on the moisture-free material:

TABLE II

	Cellulose. *Per cent.*	Ash. *Per cent.*
S. leprosula . . .	55·2	0·4
S. acuminata . . .	50·1	0·4
S. parvifolia . . .	51·4	0·5
S. bracteolata . . .	51·7	0·5

These results show that the woods all possessed a satisfactorily high cellulose content.

Microscopy of Ultimate Fibres.—Ultimate fibres were prepared from each of the four samples and examined microscopically. All four species yielded ultimate fibres which were similar in appearance, and were visible under the microscope as exceptionally thin-walled ribbons with finely tapering ends. Thin-walled vessels were also present. The dimensions of the ultimate fibres were measured by means of a projection microscope, and the figures obtained are given in the following table, which represents the results of a large number of measurements:

TABLE III.—DIMENSIONS OF ULTIMATE FIBRES

	Length.			Width.		
	Minimum. *mm.*	Maximum. *mm.*	Average. *mm.*	Minimum. *mm.*	Maximum. *mm.*	Average. *mm.*
S. leprosula . .	0·5	1·5	1·0	0·016	0·049	0·031
S. acuminata . .	0·5	1·7	1·1	0·011	0·033	0·019
S. parvifolia . .	0·5	1·5	0·9	0·011	0·043	0·027
S. bracteolata . .	0·5	1·3	0·9	0·011	0·038	0·023

It will be seen from the foregoing table that the species of *Shorea* under examination are all short-fibred woods with an average fibre length of approximately 1 mm. In this respect they resemble the deciduous hard woods (e.g. aspen, *Populus tremuloides*, with a fibre length of 0·8 to 1·7 mm., averaging 1·15 mm.) which find only a limited use in paper-making, largely as "filler" pulps in writing and printing papers. Kraft paper, on the other hand, is manufactured from long-fibred pine woods with an average fibre length of 3 to 4 mm.

On account of this poor length of the ultimate fibres obtained from the present samples of wood, it did not appear likely that they would yield strong pulps in the trials to be carried out.

I. PULPING TRIALS FOR PRODUCTION OF KRAFT PAPER

Soda Process.—The wood was converted into chips by sawing discs exactly ¾ in. in thickness from the poles at intervals along their length, and reducing these sections to chips, which were thus of uniform length. Only a few knots were encountered in the cutting of the poles, which were found to chip up readily. The chips obtained were carefully sorted free from small pieces and over-sized fragments to yield a uniform product consisting of chips approximately ¾ in. long, ¾ in. wide and 3/16 in. thick. The moisture content of the chips was estimated before the actual pulping trials.

Digestions were carried out in a rotary digester under conditions approximating to those employed commercially for the production of wood pulp by the soda process. The cooking conditions employed and the yields of pulp obtained (as percentage of moisture-free pulp on the weight of moisture-free wood) are set out in the following table:

TABLE IV.—DIGESTION DATA AND YIELDS

Digestion No.	Material.	Maximum Temperature.	Time at maximum temperature.	Strength of caustic soda solution.	Parts of caustic soda used per 100 parts of material.*	Parts of caustic soda consumed per 100 parts of material.*	Yield of moisture-free unbleached pulp.
		°C.	*Hours.*	*Per cent.*			*Per cent.*
N.009	*S. leprosula*	155	5	4	24	10·5	54·7
N.001	*S. leprosula*	160	5	4	24	12·0	53·4
N.005	*S. leprosula*	165	5	4	24	12·3	51·4
N.003	*S. acuminata*	160	5	4	24	14·7	49·1
N.004	*S. parvifolia*	160	5	4	24	13·4	49·8
N.002	*S. bracteolata*	160	5	4	24	13·1	51·3
N.010	Mixture of equal parts of *S. acuminata, parvifolia and bracteolata*	165	5	4	24	15·6	48·0

* *Expressed on the moisture-free raw material.*

These figures show that the yields of unbleached pulp obtained from the present samples were all satisfactorily high, and compare well with the yields commercially obtained in the treatment of wood by the soda process.

In the case of *S. leprosula* Trial N.009 gave a pulp containing a slight amount of shive, but digestion under the somewhat more drastic conditions employed in Trials N.001 and N.005 gave pulps which were thoroughly well broken up and free from shive. The yield of 53·4 per cent. obtained in cook N.001 was the maximum obtained from *S. leprosula* consistent with the pulp being satisfactorily digested.

S. acuminata, S. parvifolia and *S. bracteolata* were all found to behave very similarly on digestion and to give very similar yields of unbleached pulps. These three last-named woods were all a little more resistant to digestion than was *S. leprosula,* since they gave slightly shivy pulps when digested under the same conditions as (in Trial N.001) gave a clean pulp with *S. leprosula.* Owing to the similarity in their pulping properties a further cook (N.010) under rather more severe conditions was carried out on a mixture of equal parts of these three species (rather than on each individual wood) and a yield of 48·0 per cent. of well-cooked pulp was obtained.

Pulp Evaluation.—In order to evaluate the strength and general quality of the various pulps produced in the cooking trials, standard sheets for testing were prepared by means of the British Standard Sheet Machine, using the official method described in the Second Report of the Pulp Evaluation Committee of the Paper Makers' Association. The standard sheets, prior to testing, were conditioned overnight at 70° F. and 65 per cent. relative humidity. The results of the tests carried out on the sheets are given in the following table:

TABLE V.—EVALUATION OF THE UNBEATEN PULPS (STANDARD SHEETS)

	Shorea leprosula.			*Shorea acuminata.*	*Shorea parvifolia.*	*Shorea bracteolata.*	Mixture of equal parts of *S. acuminata, parvifolia* and *bracteolata.*
Digestion No.	N.009	N.001	N.005	N.003	N.004	N.002	N.010
Basis Weight, in grams per sq. metre	60·3	60·9	59·4	58·9	62·5	59·3	63·0
Thickness, microns	128	120	121	176	128	125	153
Bulk, in c.c. per gram	2·1	2·0	2·0	3·0	2·0	2·1	2·4
**Burst Factor,* in grams per sq. cm.	12·3	17·6	17·4	10·1	11·9	7·9	16·7
Breaking Length in metres	3400	4080	3730	2540	3550	2460	4170
Stretch, per cent.	1·0	1·1	1·6	1·0	0·9	0·8	1·1
Remarks	Very slightly shivy	Clean	Clean	Shivy	Shivy	Shivy	Almost free from shive

The sheets from all the pulps showed good formation, and were closely felted with a good finish.

* *Determined by the Schopper-Dalén machine.*

It will be seen from the above figures that all four woods furnished pulps of approximately the same type. The conditions employed in digestions N.001, N.002, N.003 and N.004 were identical (see

Table IV), and whereas *S. leprosula* under such conditions gave a clean, well-cooked pulp, the other three species all yielded somewhat shivy, slightly under-cooked pulps.

Considering the *S. leprosula* pulps, it will be seen that the conditions employed in cook N.001 were not only the least drastic needed for the production of a well broken-up pulp, but were also those which gave the strongest of the three pulps. Digestion N.009, although carried out under less severe conditions, yielded a weaker pulp, no doubt owing to the presence of shive, and the more drastic boil N.005 also gave an appreciably weaker product.

The pulps obtained from the other three species in digestions N.002, N.003 and N.004 were somewhat shivy and, therefore, all probably a little below the maximum strength values that could be obtained from these species. It will be observed that *S. acuminata* yielded a more bulky paper than the other species.

The pulp from digestion N.010, obtained from a mixture of equal quantities of *S. acuminata*, *S. bracteolata* and *S. parvifolia*, was the result of a more severe cook than was employed for the production of pulp from these woods when they were treated individually. It was almost free from shive, and was stronger than the pulps from digestions N.002, N.003 and N.004, and it probably approximates very closely to the maximum strength of the unbeaten soda pulp that could be obtained from the mixed raw material used. Except for a slight difference in bulk, this pulp is very close in its characteristics to the *S. leprosula* pulp from digestion N.001.

These pulp evaluation figures indicate that, as regards the properties of the unbeaten pulps, there would be little disadvantage in pulping all four species together.

Beating Effect.—In addition to the intrinsic strength of a paper-making fibre as given by the evaluation of the strength of the unbeaten pulp, it is of the greatest importance in estimating the paper-making value of a raw material to investigate the influence of beating on the properties of the pulp. The pulps selected for beating experiments in the present investigation were the *S. leprosula* pulp from cook N.009 and the pulp obtained in cook N.010 from a mixture of equal quantities of *S. bracteolata*, *S. acuminata* and *S. parvifolia*. A Lampén mill was employed for the beating trials, and the method followed was the Paper Makers' Association's Tentative Method for the Evaluation of Beating Effect, with the exception that the mill was run at 370 r.p.m. instead of 300±25 r.p.m. The results obtained are set out in Table VI.

It will be seen from the results that the strength of the pulps as measured by the breaking length, burst factor, and folding resistance, was very considerably increased by beating. Data for the tearing test were not available, but tearing by hand indicated that the tearing strength was only moderately good. This characteristic, however, which is of importance in a wrapping paper, is considered to depend more on fibre length than on the bonding of the fibre, and a high tearing strength was therefore not to be expected in sheets made from the present short-fibred pulps.

Table VI also gives, for comparison, the pulp evaluation figures supplied to the Imperial Institute by a firm of paper makers, which show the effect of beating on a commercial unbleached kraft pulp of medium strength. It will be seen that as regards breaking length the present *Shorea* pulps closely approached this kraft pulp in strength. The burst factor, on the other hand, did not reach a figure amounting to much over 60 per cent. of that attained by the beaten kraft pulp. In tearing strength and folding resistance the present pulps are also inferior to the latter.[1]

TABLE VI.—EVALUATION OF THE BEATEN PULPS (STANDARD SHEETS).

Pulp.	Revolutions of Lampén Mill.	Basis Weight.	Drainage Time at 20° C.	Breaking Length.	Stretch.	Burst Factor (Schopper-Dalén).	Folding Resistance (Schopper).
	*	*grams per sq. metre.*	*secs.*	*metres.*	*Per cent.*	*grams per sq. cm.*	*No. of double folds*
Unbleached soda pulp from *S. leprosula* (Digestion N.009)	0	60·3	—	3,400	1·0	12·3	16
	13,500	59·2	5·5	8,110	2·2	42·7	—
	36,000	59·9	7·5	9,910	2·8	53·9	2223
Unbleached soda pulp from mixture of equal parts of *S. acuminata, parvifolia* and *bracteolata* (Digestion N.010)	*						
	0	63·0	—	4,170	1·1	16·7	—
	13,500	59·4	6·6	8,710	2·3	50·3	—
Medium Strength commercial kraft pulp							*Tear Factor.*
	† 0	60·1	3·7 at 18·8° C.	2,960	2·1	21·5	252
	9,000	59·3	4·0 at 21·3° C.	8,930	3·1	75·2	250
	18,000	57·5	5·1 at 22·5° C.	10,210	3·4	80·9	242
	36,000	57·0	8·8 at 18·9° C.	10,800	3·2	83·2	235

* *Mill running at* 370 *revolutions per minute.*
† *Mill running at* 300 *revolutions per minute.*

It is thus apparent that although the strength of the pulps now under examination is good in relation to their poor fibre length, this inherent inferiority in the paper-making value of the four woods concerned renders them incapable of attaining the strength required in a good quality kraft wrapping. It is therefore not considered that an attempt to utilise young Meranti poles for the manufacture of wrapping paper would be commercially successful.

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[1] It should be mentioned that a commercial kraft pulp of *high* strength will give breaking length and burst factor values some 20 per cent. higher than those quoted in Table VI.

On the other hand the properties of the pulps suggest that if satisfactory *bleached* pulps can be prepared the materials would be of value for the manufacture of printing papers. Work on this question was subsequently carried out at the Imperial Institute and forms the subject of the succeeding section of this report. If it were found practicable to undertake the manufacture of bleached Meranti pulp for printing paper it might also be possible to utilise a certain amount of the unbleached pulp in the manufacture of low-grade wrappings, etc.

Conclusions

The present investigation has established the following conclusions:

1. The four species of young Meranti woods under examination, viz., *Shorea leprosula*, *S. acuminata*, *S. parvifolia* and *S. bracteolata*, are similar in their properties. They are all short-fibred woods, with an average fibre length of approximately 1 mm. in each case.
2. All four species behaved very similarly on pulping by the soda process, and would be capable of being pulped together.
3. High yields of unbleached pulp were obtained.
4. In the pulp evaluation determinations and beating trials which were carried out the pulps developed good strength values in relation to their poor fibre length, but proved incapable of reaching the strength figures required of a good quality kraft pulp.
5. Although it would not be a commercial proposition to undertake the manufacture of wrapping paper from these Meranti poles, the properties of the pulps suggest that the materials may have a value for the manufacture of printing papers, a question dealt with in the next section of this report.

II. THE MANUFACTURE OF BLEACHED SODA PULPS

Pulping Trials.—The pulps dealt with in the preceding section had been prepared by digestion under relatively mild conditions in order to preserve strength and secure a high yield, but were found to be for practical purposes virtually unbleachable. A series of pulping experiments was accordingly carried out under a variety of more severe cooking conditions. In each trial the yield of unbleached pulp was determined and the bleachability of the pulp assessed by the determination of its permanganate number. The digester employed was a phosphor bronze rotary.

In working out the effect on yield and bleachability of changes in the cooking conditions the wood chiefly studied was *S. leprosula*—the most abundant species. A few additional trials were also made in order to ascertain how the other species behaved when treated under similar conditions. The results obtained with *S. leprosula* are given in Table VII below.

With reference to the final column in the table, viz. the bleaching powder in terms of standard bleach (35 per cent. available chlorine) equivalent to the permanganate number, it must be pointed out that this figure is derived from the permanganate number and is not to be taken as the bleach actually required to produce a pulp of a good commercial white. It was found experimentally that the bleach required is in excess of that calculated from the permanganate number. This also is the experience with commercial soda pulps. With this reservation, the permanganate numbers may be taken as a rapid and convenient method of comparing the bleachability of the different pulps.

TABLE VII

SODA PULPING TRIALS WITH SHOREA LEPROSULA

Digestion.	Maximum Temperature.	Time at Maximum Temperature.	Parts of NaOH per 100 parts moisture-free wood.	Concentration of NaOH solution.	Yield of moisture-free unbleached pulp on moisture-free wood.	Permanganate number.	Standard bleach requirement on basis of permanganate number.
	°C.	*Hours.*	*Parts.*	*Per cent.*	*Per cent.*		
N.009	155	5	24	4	54·7	48·4	40·0
N.086	160	5	30	6	49·9	20·8	31·0
N.087	165	5	30	6	46·5	16·2	23·5
N.089	165	7	30	6	43·3	13·9	19·7
N.085	170	5	30	6	43·2	13·2	18·6
N.088	180	5	30	6	35·6	11·7	16·2

It will be seen from these results that, by employing fairly severe pulping conditions, it was possible to produce pulps of moderate bleachability. Except in the case of run N.088 the yields of unbleached pulp were all over 43 per cent., which may be considered satisfactory. Run N.088 was carried out at a high temperature, viz. 180° C. (equivalent to 151 lb./sq. in. gauge pressure) in the presence of a high alkali concentration. The yield of unbleached pulp in this trial fell abruptly to 35·6 per cent. without a corresponding large increase in bleachability as reflected in the permanganate number. In fact, when the bleachability of the pulp was checked by small scale bleaching tests with bleaching powder solution it was found to be less easily bleached than pulp N. 085, and to exhibit signs of over-cooking. It was evident, therefore, that no advantage would accrue from the use of even more severe conditions and that runs N.087 and more especially N.089 and N.085 represent reasonable commercially practicable sets of cooking conditions.

Table VIII compares the results on pulping *S. acuminata, S. parvifolia* and *S. bracteolata* with those obtained on cooking *S. leprosula* under the same sets of conditions. It will be seen that the different species give results which are generally very similar. *S. acuminata, S. parvifolia* and *S. bracteolata* are, however, all slightly inferior to *S. leprosula* in yield with *S. bracteolata* giving the highest yield of the three.

TABLE VIII

COMPARISON OF SODA PULPING TRIALS ON THE THINNINGS OF DIFFERENT SPECIES OF MERANTI WOODS

Digestion.	Raw Material.	Conditions of Digestion.				Yield of moisture-free unbleached pulp on moisture-free raw material.	Permanganate number of unbleached pulp.
		Maximum Temperature.	Time at Maximum Temperature.	Parts of NaOH per 100 parts moisture-free raw material.	Concentration of NaOH solution.		
		° C.	*Hours.*		*Per cent.*	*Per cent.*	
N.001	*S. leprosula*	160	5	24	4	53·4	—
N.087		165	5	30	6	46·5	16·2
N.085		170	5	30	6	43·2	13·2
N.003	*S. acuminata*	160	5	24	4	49·1	—
N.095		165	5	30	6	42·1	22·5
N.004	*S. parvifolia*	160	5	24	4	49·8	—
N.096		165	5	30	6	41·5	23·0
N.002	*S. bracteolata*	160	5	24	4	51·3	—
N.091		165	5	30	6	43·5	19·2
N.092		170	5	30	6	39·5	17·3

Furthermore, the permanganate numbers of the three aforementioned pulps are all higher than the corresponding figure for *S. leprosula,* the species most resembling *S. leprosula* again being *S. bracteolata.*

From these results it is to be concluded that although the other species examined all give slightly lower yields of pulps which are rather "harder" than those derived from *S. leprosula,* the differences between the species are not such as to make it necessary to pulp them separately. The only effect of a proportion of the other species being mixed with *S. leprosula* will be to depress the yield slightly and increase the bleach requirement of the pulp. These effects will be least evident when the species mixed with *S. leprosula* is *S. bracteolata.*

It is not, of course, possible to state categorically the cooking conditions which would be most suitable for the commercial cooking of Meranti wood thinnings. This would depend upon the precise nature of the pulp which it is desired to manufacture and upon costing considerations. The pulping process involves several variables which can be manipulated so that, within limits, it is possible to arrive at a satisfactory pulp in more than one way. The cost of chemicals at the mill site relative to the cost of power would require to be known, and the most economic digestion conditions worked out on the basis of these considerations. Nevertheless, the experimental trials sufficiently demonstrate the pulping characteristics of the raw material and indicate the type of result to be expected. It is probable that mill cooking conditions would not depart very fundamentally from those of other runs, *e.g.*, N.085 and N.087.

Properties of Papers from Bleached Meranti Wood Soda Pulps.—Bleached papers from Meranti wood were of satisfactory colour for soda pulps. They were only of moderate strength but for many grades of writing papers and for most printing papers high strength properties are not essential. Moreover, when necessary, the strength of the paper could be improved by the incorporation of a percentage of a stronger type of pulp in its furnish. The papers were of excellent formation and the sheets were well-closed. On heavy beating they became dense and rattly. The opacity of the papers was rather poor even with light beating, and on heavy beating the papers became very transparent. This property would impose certain restrictions on the types of paper which could be manufactured from Meranti thinnings. Nevertheless, the defect is not always serious and in many cases poor opacity can, in certain measure, be dealt with by reducing beating time to a minimum, using fillers, or employing mixed furnishes containing a more opaque pulp.

A few actual printing trials were made with Meranti papers on a proofing press and the impressions were quite satisfactory. As, however, it was not possible to conduct the trials under rigidly controlled conditions, the results cannot be regarded as permitting any relative evaluation of the printing properties of the papers.

Conclusion

The present report shows that technically it would be possible to manufacture bleached pulps from Meranti wood thinnings. By the use of suitable digestion conditions satisfactory yields of pulps of moderate bleachability can be obtained. After bleaching these pulps would be suitable for the manufacture of many classes of printing and writing paper, but not for grades for which high strength or good opacity is demanded. Furthermore, as was demonstrated in Part I of this report, unbleached soda pulps from these thinnings, although inferior to commercial kraft pulps, could nevertheless be employed for the production of lower grade wrapping papers.

From the economic standpoint the prospects of utilising this material for paper-making may be less favourable. Meranti thinnings are not of the highest value for paper-making and alternative raw materials of more value and greater versatility in use may be available in Malaya. Before the pulping of Meranti thinnings could be undertaken commercially it would be necessary to have assurance that substantial quantities of raw material would be regularly forthcoming and could be easily and cheaply transported to the mill site.

Finally, since it would be very difficult to operate a mill with economic success unless it was of moderately large capacity, it would be very necessary to examine the potential output of the pulp and paper in relation to local consumption and potential markets for the grades which could be manufactured.

NOTES

Recent Research on Empire Products in Nigeria.—The following information relating to research work carried out in Nigeria during 1944-45 or still in progress, is taken from a report sent to the Imperial Institute by Mr. L. Nicholls, Chief Conservator of Forests.

North-East Circle.—A small scale experiment in the propagation of bamboos is being carried out at Naraguta from stock received recently from the Provincial Forest Officer, Oyo. The local indigenous bamboo (*Oxystenanthera*) is one of the small varieties and it is desired to introduce other species such as *Dendrocalamus* and *Bambusa* spp. with a view to providing a bigger and better bamboo for local house roofing and building purposes. Germination tests on several indigenous species have been carried out at Naraguta where the permanent nursery has been considerably enlarged and space allocated for transplanting brakes to contain large quantities of two-year-old stock.

North-West Circle.—Owing to the shortage of staff, experimental and research work has had to be curtailed. The fire control experiments in Sokoto, Katsina and Zaria Provinces have been maintained and the annual prescriptions carried out. These plots are now due for the first quinquennial reassessment. The experiment with natural regeneration of *Triplochiton* in a Niger " Kurmi " has had to be abandoned, no staff being available to supervise it. A two acre plot of *Guiera* scrub at Daura in Katsina Province which has been protected for about seven years shows phenomenal growth when compared with the surrounding bush which has been subjected to browsing, and indiscriminate hacking. With the co-operation of the Agricultural Department experiments in establishing live fences are being continued, but progress towards a really effective hedge is slow.

South-Central Circle.—For the purpose of ascertaining the volume of merchantable timber the Benin forests are capable of producing, a square mile—Compartment 11 of the Sapoba Reserve—of average forest has been selected and is in process of being fully exploited by the United Africa Company ; twelve economic species are being felled. At the time of writing about one-eighth has been cut over and 158 trees have been taken out producing just under 65,000 cubic ft. of logs. These figures have not been finally checked but are sufficiently accurate to indicate what volume may be expected. This will be of the order of half a million cubic ft. for the whole square mile.

In Ondo Province an experiment has been commenced in a compartment of the Akure Reserve. This compartment had been completely exploited for the sawmill without any pre-exploitation regeneration operations being carried out. The entire compartment was cleaned and climbers cut back. A seedling count was made with the astonishing result that 220 seedlings of valuable species per acre were found. Of these *Triplochiton scleroxylon* averaged 12 seedlings per acre, *Sterculia rhinopetala* 13, *Terminalia superba* 10, *Entandrophragma* spp. 13, *Celtis soyauxii* 11, *Guarea cedrata* 15, *Mansonia altissima* 11 and *Cistanthera papaverifera* 12 seedlings per acre. One half of the compartment will continue to be tended and the young stock kept free from competitive growth. The remaining half will be left untreated in future as a control.

South-West Circle.—In the Abeokuta charge, apart from the information obtained on natural regeneration in the Ilaro reserves and planting technique in the Apapa area, the only research work is the remeasurement of the sample plots laid down at Akilla; these give valuable data. In Oyo Province pressure of work in connection with production has precluded anything in the nature of research work. The same applies to Ilorin, where in actual fact a forest officer was only posted to the charge for less than four months for the period under discussion. General experimental work has continued, however, at the Sobi plantations in connection with planting in waterlogged areas.

Sericultural Legislation in the Argentine.—In recent years important steps have been taken in the Argentine to promote the sericultural industry. Notably, in 1942, a Division of Sericulture was constituted in the National Ministry of Agriculture, and an Institute of Sericulture founded in Cordoba province. Sericulture is established in a number of Provinces, and the present order of importance is reported to be: Cordoba, Santa Fé, Mendoza, Tucuman, and Buenos Aires.

It is of interest to record that the Argentine authorities are making considerable use of the elementary schools to aid in the dissemination of knowledge of silkworm rearing, and also generally to widen interest in the industry. In this connection free distribution of silkworm "seed," mulberry seed and plants is authorised to schools, institutions, and official and municipal organisations.

Through the courtesy of the Agricultural Counsellor of the Argentine Embassy in London the Imperial Institute has obtained access to a number of papers relating to the functions of official bodies for the control of the Argentine silk industry and to the legislative powers taken for its regulation. The following free translation and summary of what appear to be the more important of these papers is published as likely to be of general interest in Empire countries. The summary includes: (1) Functions of the Division of Sericulture of the Ministry of Agriculture; (2) Silkworm Seed Regulations of the Division of Sericulture; (3) Functions of the Sericultural Institute of Cordoba; (4) Silkworm Seed Regulations applicable to the Province of Cordoba.

(1) *Division of Sericulture—Ministry of Agriculture.* The functions of the Division of Sericulture, as outlined in Decree No. 117,144 (1942) may be summarised as follows:

(i) to arrange for necessary experimental work and to organise the establishment of such sericultural stations as are required ;

(ii) to promote and improve mulberry culture for silkworm rearing ;

(iii) to determine the best races and varieties of silkworms and those most suited to the different regions of the country ;

(iv) to establish means to guarantee the quality of silkworm eggs, in accordance with present scientific methods, and to endeavour to improve these methods by investigation ;

(v) to set up standards for the classification of cocoons ;

(vi) to resolve within the limits of the Division's resources problems arising in connection with the sale and utilisation of cocoons ;

(vii) to distribute eggs, silkworms and grafted mulberries at reduced prices to peasants who require them ;

(viii) to regulate and guide all matters relative to silkworm rearing, silkworm gut production, mulberry culture, and to conduct necessary propaganda for this purpose ;

(ix) to keep a register of mulberry cultivators, silkworm rearers and silk manufacturers ;

(x) to arrange in collaboration with the Directorate of Agricultural Education for sericultural instruction of both sexes with the purpose of training sericulturists and reelers ;

(xi) to keep the census of mulberry trees up to date in collaboration with the other authorities concerned ;

(xii) to consult generally with the Ministry of Agriculture concerning matters affecting the sericultural industry and to solicit the collaboration of Provincial Governors in the development of this industry.

The Directorate of Agriculture shall collaborate with the Division of Sericulture in the production of mulberry planting material to be sold to cultivators at reduced prices.

(2) *Silkworm Seed Regulations.* Under the powers granted by Decree No. 139,606 the following regulations have been issued as Resolution No. 41,080 of 17/3/43 :

(i) the Institutes, whether official or otherwise, and individuals taking up the production of silkworm seed must apply to the Division of Sericulture to be entered on the official register, thereby contracting the obligation to observe the method of examination for the control of disease originally devised by Pasteur ;

(ii) by " seed " is meant the eggs of the moth (*Bombyx mori*) from which silkworms are produced. Such seed shall be classified as follows :

(*a*) *Original Seed.* By this is understood only such seed as comes from official establishments specialising in its production, and representing the best grade as regards purity and quality.

(*b*) *Seed of the First Multiplication.* By this is meant seed produced by reproduction from original seed, carried out by institutions whether official or otherwise.

(*c*) *Seed of the Second Multiplication.* This is seed reproduced from (*b*) above by individuals;

(iii) seed producers entered on the register will at the proper time ask the Division of Sericulture to send an inspector, who will license the seed, handing over to the Bacteriological Laboratory of the Directorate of Livestock each female moth, numbered according to the wrapping in which the corresponding seed will be enclosed. The seed shall remain in the possession of the producer who shall not dispose of it until the bacteriological report is made;

(iv) if after examination by the Bacteriological Laboratory the seed is found to be free from disease the Division of Sericulture will inform the producer of the number corresponding to the bacteriological report, and this number shall appear upon the wrappings of seed to be distributed. The inspector of the above Division will inspect the packing which, in every case, he shall mark, sign and seal;

(v) when the above procedure is completed the Division of Sericulture will issue the corresponding certificate in which shall be stated the classification, freedom from disease, race of silkworm, date of oviposition, name of producer and zone of production according to the requirements of Law 11,275;

(vi) the wrappings will be supplied by the above Division and no seed may be employed unless it has official wrappings;

(vii) should the seed be found to contain *Nosema bombycis* N., or any other infectious organism, the Division of Sericulture will inform the producer in question so that in the presence of the inspector he may proceed to the disinfection of the premises and equipment used in production;

(viii) the Bacteriological Laboratory and the Division of Sericulture are authorised to confiscate and burn any lot of silkworm seed in which the microspores of *Nosema bombycis* N. shall be found;

(ix) the registered establishments may, if they wish, apply to have their seed graded, and if they ask for this shall pay a fee of 0·10 pesos per gram;

(x) on packings and in descriptions the use of terms otherwise than those provided in section (ii) above is prohibited, e.g. unofficial terms such as selected seed, graded seed, guaranteed seed, etc., may not be used;

(xi) all seed imported into the country must be accompanied by a health certificate granted by the competent authority of the country of origin, and one recognised by the Division of Sericulture, which will then give the necessary permission for distribution in the country. Failing such a certificate the Division shall send the seed to the Bacteriological Laboratory to be licensed, for which service a fee of 0·10 pesos per gram is charged. In no case can seed be distributed without the certificate of the Division of Sericulture ;

(xii) in order to provide for the proper conduct of seed production, the Division of Sericulture independently, or in collaboration with the Bacteriological Laboratory, may at any time inspect seed-raising establishments ;

(xiii) the Division of Sericulture has the power to charge producers for the wrappings mentioned in section vi.

(3) *Sericultural Institute of Cordoba.* This provincial institute is constituted under Cordoba Provincial Law No. 3,994 (1942), to organise sericulture in Cordoba Province in co-operation with the Division of Sericulture of the National Ministry of Agriculture. Its functions are similar to those already outlined for the Division of Sericulture, e.g. to study silkworm and mulberry varieties, to arrange for the production of silkworm seed, and to license and supervise producers, etc.

(4) *Silkworm Seed Production* (*Cordoba*). The following regulations for silkworm seed production have been drawn up for Cordoba under Decree No. 28,676 Series C (1943) :

(i) all sericulturists undertaking the production of seed shall be enrolled in the registers kept by the Institute of Sericulture showing location of establishment, date of commencement of incubation, and number of races put to incubate ;

(ii) prior to enrolment the Institute of Sericulture will arrange for inspection of the premises, and the equipment to ensure isolation of the eggs laid, and if satisfactory shall furnish written authority to engage in egg production ;

(iii) the authorised seed producer shall at all times admit the Inspectors of the Institute who will satisfy themselves as to the health of the silkworms, methods of rearing, etc. ;

(iv) when rearing is finished seed production may proceed provided that no adverse reports have been made by the Inspectors of the Institute of Sericulture, but only on condition that the eggs laid (seed) are isolated ; the date of oviposition must be communicated to the Director of the Sericultural Institute so that inspection can be arranged ;

(v) when egg laying is finished, the inspectors shall furnish a declaration specifying the number of female moths ovipositing, examine a number of them to verify their healthiness, and give the results of such examination ;

(vi) at the proper time, and under the supervision of the Sericultural Institute, the washing and packing of the seed for hibernation will be proceeded with ; the seed shall be properly packed and sealed, the weight being recorded on the wrappings, and will remain in the possession of the producer for sale as seed licensed and guaranteed by the Sericultural Institute ;

(vii) should the producers desire to sell a smaller quantity of seed, application may be made to the Institute of Sericulture for the inspection and sealing of a fresh packing;

(viii) seed producers shall keep a book in which shall be entered the quantity of seed sold and transferred, indicating the purchaser and destination, and shall fortnightly furnish such particulars to the Institute;

(ix) penalties including confiscation of the seed are provided for infringements of these regulations.

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Home Curing of Bacon and Hams. Compiled by the Small Pig Keepers' Council. *Bull. No.* 127, *Minist. Agric., Lond.* Pp. 62, 9½ × 6. (London : H.M. Stationery Office, 1945.) Price 1*s.* 3*d.*

Fellmongering Investigations. Papers I to XII. By F. G. Lennox, M. E. Maxwell and W. J. Ellis. *Bull. No.* 184, *Coun. Sci. Industr. Res. Aust.* Pp. 232 + 8 plates, 9½ × 6. (Melbourne : Government Printer, 1945.)

The Life-History of the Spiny Dogfish (*Squalus scanthias*) and the Vitamin A values of Dogfish Liver Oil. By W. Templeman. *Res. Bull. No.* 15 (*Fish.*), *Dep. Nat. Resources, Newfdld.* Pp. 102, 9 × 6. (St. John's : Department of Natural Resources, 1944.)

Guide to Commercial Shark Fishing in the Caribbean Area. Pp. 149, 9 × 6. (Washington, D.C.: Anglo-American Caribbean Commission, 1945.) Gives information of the varieties and location of sharks in the area, with particulars of by-products, commercial and nutritional value, and the methods of catching, processing and marketing.

Curing and Canning of Prawns. By B. N. Chopra. *Indian Frmg.*, 1945, **6**, No. 6, 260-265.

Bee-keeping. By C. G. Butler. *Bull. No.* 9 (*New Ed.*), *Minist. Agric., Lond.* Pp. 27, 9½ × 6. (London: H.M. Stationery Office, 1945.) Price 9*d.*

FORESTRY

General

Report on the Forestry Department, Gold Coast, for 1944-45. Pp. 7, 13 × 8. (Accra: Government Printing Department, 1945.)

Notes on some Gold Coast Trees. Compiled by D. Kinloch, Assistant Conservator of Forests, and edited by R. C. Marshall, Chief Conservator of Forests. Pp. 70,, 8½×5½. (Accra: Government Printing Department, 1945). Price 2*s* 6*d.*

Forestry in the Northern Territories of the Gold Coast. By R. C. Marshall. Pp. 13, 13 × 8. (Accra: Government Printing Department, 1945.) Price 1*s.*

Annual Report on the Forest Department, Jamaica, for the year ended March 31, 1945. Pp. 9, 13 × 8. (Kingston: Forest Department, 1945.) Mimeographed.

Forestry in the Leeward Islands. Barbuda. Report by the Conservator of Forests, Trinidad and Tobago. After Preliminary Visit by J. S. Beard, Assistant Conservator. *Bull. No.* 7B, *Development and Welfare in the West Indies.* Pp. 13, 9½ × 6. (Bridgetown, Barbados: The Advocate Co., 1945.) Price 5 cents.

Annual Report of the Director of Forestry, New Zealand, for the year ended March 31, 1945. Pp. 35, 13 × 8. (Wellington, N.Z.: Government Printer, 1945.) Price 1*s.*

Report on the Forest Administration of Sierra Leone, for 1944. Pp. 14, 9¾ × 6. (Freetown: Government Printer, 1945.)

Annual Report of the Forest Department, Uganda, for 1944. Pp. 8, 10 × 8. (Entebbe: Government Printer, 1945.) Price Sh. 1/-.

The African Alpine Bamboo. By S. H. Wimbush. *Emp. For. J.*, 1945, **24**, No. 1, 32-39. An account of the distribution, uses and growth of *Arundinaria alpina* in East Africa.

Little Leaf Disease of Pine. By G. H. Hepting, T. S. Buchanan and L. W. R. Jackson. *Circ. No.* 716, *U.S. Dep. Agric.* Pp. 15, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 5 cents.

Timber

East African Timber Production. By A. Rule. *Emp. For. J.*, 1945, **24**, No. 1, 47-51.

Timbers of West Africa. Pp. 80, 7½ × 5. (London: Timber Development Association, Ltd., 1945.)

Timbers of the New Guinea Region. By H. E. Dadswell. *Trop. Woods*, 1945, No. 83, 1-14.

Investigation of the Boric Acid Treatment of White Cheesewood (*Alstonia scholaris*). By A. R. Brimblecombe. *Aust. Timb. J.*, 1945, **11**, No. 7, 329-331. Deals with the results obtained in treating this timber to preserve it against the powder post beetle.

Report on the Survey of the Insects and Pests attacking the Bermuda Cedar. By R. L. Parker. Pp. 5, 13 × 8. (Hamilton; Bermuda Press, Limited, 1945.)

Études de quelques propriétés des charbons de bois du Québec se rapportant à leur utilisation comme carburant dans les gazogènes. By J. Risi, M. Brûlé and M. Picard. *Bull. No.* 6 (*Nouvelle série*), *Minist. Terres et Forêts, Québec.* Pp. 30, 9 × 6. (Quebec: Department of Lands and Forests, 1945.)

Étude du mécanisme de carbonisation de quelques espèces de bois de la province de Québec. By J. Risi and M. Deschênes. *Bull. No.* 7 (*Nouvelle série*), *Minist. Terres et Forêts Québec.* Pp. 35, 9 × 6. (Quebec: Department of Lands and Forests, 1945.)

La fabrication du charbon de bois. Renseignements pratiques pour les charbonniers. By J. Risi. *Bull. No.* 8 (*Nouvelle série*), *Minist. Terres et Forêts Québec.* Pp. 44, 9 × 6. (Quebec: Department of Lands and Forests, 1945.)

Gums and Resins

How to Grow Good Lac. By Bhagat Singh Chhabra. *Indian For.*, 1945, **71,** No. 7, 217-220.

A Study on the Constitution of Soft Lac Resin. By T. Bhowmik and H. K. Sen. *J. Indian Chem. Soc., Industr. News Ed.*, 1944, **7,** Nos. 3 and 4, 160-162.

Cashew Nut Shell Liquid (C.N.S.L.) Resins. By J. D. Morgan. Pp. 13, 8½ × 6. Reprinted from *J. Oil Col. Chem. Assoc.*, 1945, **28,** No. 298, 65-78.

IMPERIAL INSTITUTE

CONSULTATIVE COMMITTEE ON INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

QUARTERLY BIBLIOGRAPHY OF INSECTICIDE MATERIALS OF VEGETABLE ORIGIN, NO. 32

(July to September 1945)

Compiled by Miss R. M. Johnson

With the collaboration of the Imperial Institute of Entomology and the Department of Insecticides and Fungicides, Rothamsted Experimental Station.

GENERAL

Mineral Oils, Alone or Combined with Insecticides, for Control of Earworms in Sweet Corn. By G. W. Barber. *Tech. Bull. No.* 880, *U.S. Dep. Agric.*, 1944. Pyrethrum, rotenone and derris among the insecticides included in the tests.

Control of the Cabbage Aphid (*Brevicoryne brassicae*) in Cabbage Plant Beds and Seed Fields. By E. P. Breakey and E. C. Carlson. *Ann. Rep. Wash. Agric. Exp. Sta.* 1943-44, (*Bull. No.* 455), p 38. Nicotine dust effective; pyrethrum and rotenone not so satisfactory.

The Asparagus Beetle (*Crioceria asperagi*) as a Pest of Asparagus in Eastern Washington. By R. D. Eichmann and R. L. Webster. *Ann. Rep. Wash. Agric. Exp. Sta.* 1943-44, (*Bull. No.* 455), p 36. Nicotine, rotenone, pyrethrum and sabadilla dusts tested: sabadilla as effective and quick in killing the beetle as rotenone; immediate effect with nicotine dust.

Control of European Corn Borer and Ear Smut on Sweet Corn with Dusts and Sprays. By B. B. Pepper and C. M. Haenseler. *Circ. No.* 486, *N.J. Agric. Exp. Sta.* (*R.A.E.*, 1945, **33**, A, Pt. 8, 239-240). Experiments carried out with derris, cube and nicotine.

The Heather Beetle (*Lochmaea suturalis*). By A. E. Cameron, J. W. McHardy and A. H. Bennett. *Publ. Brit. Field Sports Soc.*, 1944. (*R.A.E.*, 1945, **33**, A, Pt. 8, 233). Dusts of derris or derris and pyrethrum destroyed a large proportion of the larvae when applied in early August.

Experiments on the Control of Cabbage Pests in North Queensland. By T. Greaves. *J. Coun. Sci. Industr. Res. Aust.*, 1945, **18**, No. 2, 110-120. Derris, nicotine and timbo were among the materials tested.

The Control of Tomato Pests. By W. J. S. Sloan. *Queensld. Agric. J.*, 1945, **61**, Pt. 1, 17-41. Nicotine recommended for the control of the jassid (*Empoasca terra-reginae*), aphids and the tomato mirid, pyrethrum for *Nysius vinitor* and derris for *Nezara viridula* and other vegetable thrips.

Experiments with DDT, Sabadilla and Pyrethrum Dusts for the Control of *Lygus* spp. on Seed Alfalfa. By F. V. Lieberman. E-658, *U.S. Dep. Agric., Bur. Entomol.*, 1945. (*Amer. Chem. Absts.*, 1945, **39**, No. 14, 3110.)

DDT and "Ryanex" to Control Oriental Fruit Moth in Quince. By E. H. Whealer. *J. Econ. Ent.*, 1945, **38**, No. 2, 281-282. "Ryanex" is a preparation obtained from *Ryania speciosa*: a nicotine preparation also included in the tests.

DDT Aerosols for Pea Aphid Control. By L. P. Ditman, F. F. Smith, L. D. Goodhue and T. E. Bronson. *J. Econ. Ent.*, 1945, **38**, No. 2, 183-188. Experiments on the comparative effectiveness of varying dosage of nicotine or derris resin and DDT when applied in aerosol form were carried out.

DDT and other Insecticides as Residual-Type Treatments to Kill Bedbugs. By A. H. Madden, A. W. Lindquist and E. F. Knipling. *J. Econ. Ent.*, 1945, **38**, No. 2, 265-271. Insecticides of vegetable origin included in the tests.

Experiments with Aerosols Against Some Pests of Truck Crops. By F. F. Smith, L. P. Ditman and L. D. Goodhue. *J. Econ. Ent.*, 1945, **38**, No. 2, 189-196. Aerosols containing DDT appeared to be more efficient against a number of pests of vegetables than those containing derris or nicotine.

New Sprayer for Testing Aerosols. By G. H. Batt. *Soap*, 1945, **21**, No. 7, 117, 119, 121.

Insecticide and Germicide. U.S. Pat. No. 2,358,986. *Soap*, 1945, **21**, No. 7, 123. Containing pyrethrum, rotenone or nicotine.

Insecticide Outlook. Discussed in the light of war-time developments and the raw material situation. By J. Rodda. *Soap*, 1945, **21**, No. 8, 112-113, 121.

Process for Increasing the Efficiency of Insect Destroying Drug Extracts [of Vegetable Origin]. U.S. Pat. No. 2,376,702. *Soap*, 1945, **21**, No. 8, 73.

ALKALOID-CONTAINING MATERIALS

Tobacco Products, including Nicotine and Nicotine Derivatives

The Carrot Root Aphid. By H. Jarvis. *Queensld. Agric. J.*, 1945, **60**, Pt. 6, 353-354. Nicotine dust useful in control.

Insect Pests of *Cotoneaster horizontalis*. By G. F. Wilson. *J. Roy. Hort. Soc.*, 1945, **70**, Pt. 9, 271-275. Nicotine dust used for the control of the woolly aphis, the pyralid moth, the bud moth (*Ancylis achatana*) and the hawthorn webber: nicotine spray for the European brown scale.

The Pear Slug. By C. F. H. Jenkins. *J. Dep. Agric. W. Aust.*, 1945, **22**, No. 1, 41-42. Nicotine sulphate spray effective in control.

The Yew Scale. By G. F. Wilson. *J. Roy. Hort. Soc.*, 1944, **69**, Pt. 8, 244-248. (*R.A.E.*, 1945, **33**, Pt. 6, 171.) Nicotine spray effective method of control.

The Mushroom Mite (*Tyrophagus lintneri* (Osborn)) as a Pest of Cultivated Mushrooms. By A. C. Davis. *Tech. Bull. No.* 879, *U.S. Dep. Agric.* Nicotine only of limited value in controlling the pest.

The Black Thrips (*Heliothrips haemorrhoidalis*). *Agric. Gaz. N.S.W.*, 1945, **56,** Pt. 4, 162. Nicotine recommended for control.

Mosquito Control in Michigan—1944. By E. I. McDaniel. *Quart. Bull. Mich. Agric. Exp. Sta.*, 1944, **26,** No. 4, 105. (*R.A.E.*, 1945, **33,** B, Pt. 7, 105.) Spraying with nicotine sulphate recommended for the control of adult mosquito on lawns or in parks.

Manufacture of 40 per cent. Nicotine as a Solution of Nicotine Sulphate in Water. By T. S. Subramanian and M. C. Variyar. *J. Sci. Industr. Res. India*, 1944, **3,** No. 4, 143-148.

How to Make Tobacco-Wash on the Farm. By M. C. Mossop. *Rhod. Agric. J.*, 1945, **42,** No. 2, 175-177.

DDT for the Control of Grape Leafhoppers. By J. A. Cox. *J. Econ. Ent.*, 1945, **38,** No. 2, 278-279. Tested as a substitute for nicotine sulphate.

Relative Toxicity of Nicotine and Nornicotine. By P. S. Larson, H. B. Haag and J. K. Finnegan. *Proc. Soc. Exptl. Biol. Med.*, 1945, **58,** 231-232. (*Amer. Chem. Absts.*, 1945, **39,** No. 12, 2572.)

Alkaloids in *Nicotiana attenuata* and *N. trigonophylla.* By C. V. Bowen. *J. Amer. Pharm. Assoc., Sci. Ed.*, 1945, **34,** No. 7, 199.

INSECTICIDE MATERIALS CONTAINING ROTENONE AND ALLIED SUBSTANCES

General

The Apple Maggot. By C. R. Cutright and T. H. Parks. *Bi-mthly Bull. Ohio Agric. Exp. Sta.*, 1944, **29,** No. 228, 168-172. (*R.A.E.*, 1945, **33,** A, Pt. 6, 191.) Rotenone dust effective in controlling the pest.

The Cabbage Maggot. By W. D. Whitcomb. *Bull. No.* 412, *Mass. Agric. Exp. Sta.*, 1944. (*R.A.E.*, 1945, **33,** A, Pt. 6, 177-178.) Cube or derris dusts unsatisfactory for controlling the pest.

Biology and Control of Potato Flea Beetles in Eastern Washington. By R. L. Webster *et al.* *Ann. Rep. Wash. Agric. Exp. Sta.*, 1943-44, (*Bull. No.* 455), pp. 36-37. Rotenone not very satisfactory.

Derris et Lonchocarpus. *Bull. Agric. Congo Belge, Bruxelles*, 1943, **34,** Nos. 1 and 2, 259-261. Note on these two insecticides and their possibilities for the Belgian Congo.

DDT to Control Potato Insects. By G. G. Gyrisko, J. F. T. Jodka and W. A. Rawlins. *J. Econ. Ent.*, 1945, **38,** No. 2, 169-173. Comparisons made with other insecticides including rotenone.

DDT in Agriculture. *Chem. Tr. J.*, 1945, **117,** No. 3035, 79. To be employed in Oregon in the campaign against the potato tuber beetle: formerly rotenone and calcium arsenate were used.

Rotenona. Caracteristicas y usos en entomología. By S. G. de Haro. *Ion*, 1945, **5,** No. 47, 399-404.

Scarce Rotenone Insecticide now " Stretched " with Synthetic Lethane. *Soap*, 1945, **21,** No. 8, 84.

Stabilisation of Rotenone Preparations. U.S. Pat. No. 2,375,774. *Amer. Chem. Absts.*, 1945, **39,** No. 16, 3619. A preparation is made containing rotenone, starch and an inorganic salt.

Application of a Modified Red Colour Test for Rotenone and related Compounds to Derris and Lonchocarpus. By M. A. Jones. *J. Assoc. Off. Agric. Chem.*, 1945, **28,** No. 22, 352.

Summary of Field Experiments with DDT and Rotenone used in Red Scale Control. By W. Ebeling. *Calif. Citrog.*, 1945, **30,** No. 6, 164. (*Exp. Sta. Rec.*, 1945, **93,** No. 3, 320.)

Derris

Propagating Derris by Cuttings. By D. G. White. *Agric. in Americas*, 1945, **5**, No. 8, 154-156.

The Control of the Sheep Tick (*Ixodes ricinus* L.) by Treatment of Farm Stock. By A. Milne. *Ann. Appl. Biol.*, 1945, **32**, No. 2, 128-142. Discusses the value of derris for the purpose.

The Penetration of Derris through the Spiracles and Cuticle of *Melophagus ovinus* L. By J. E. Webb. *Bull. Ent. Res.*, 1945, **36**, Pt. 1, 15-22.

Wasp Damage and Nuisance. *Food Tr. Rev.*, 1945, **15**, No. 8, 10. Derris powder recommended for treating entrance to nest.

Cube

Field Trials with Dichlorodiphenyltrichlorethane (DDT) against the Raspberry Beetle (*Byturus tomentosus*). By H. Shaw. *J. Pomol.*, 1945, **21**, 140-145. (*Amer. Chem. Absts.*, 1945, **39**, No. , 3388.) Sprays containing 0.025-0.05 per cent. DDT gave as good a control as a Lonchocarpus spray containing approximately 0.011 per cent. rotenone.

Others

Research Prepares Way for Domestic Insecticide Production. *Rep. Admin. Agric. Res., U.S. Dep. Agric.*, 1944, p. 204. Refers to the development of cultivation of *Tephrosia virginiana* in the U.S. as a source of rotenone.

PYRETHRIN-CONTAINING MATERIALS

The Structure of Pyrethrolone and Related Compounds. Part IV. By T. F. West. *J. Chem. Soc.*, 1945, June, 412-414.

Constituents of Pyrethrum Flowers. By F. B. La Forge and W. F. Barthel. XVII. The Isolation of Five Pyrethrolone Semicarbazones. XVIII. The Structure and Isomerism of Pyrethrolone and Cinerolone. XIX. The Structure of Cinerolone. *J. Org. Chem.*, 1945, **10**, No. 2, 106-113; No. 3, 222-227.

Experiments on the Synthesis of the Pyrethrins. Part I. Synthesis of Chrysanthemum Monocarboxylic Acid. By I. G. M. Campbell and S. H. Harper. *J. Chem. Soc.*, 1945, May, 283-286.

The Present Outlook on the Gypsy Moth Problem. By R. C. Brown and R. A. Sheals. *J. For.*, 1944, **42**, No. 6, 393-407. (*R.A.E.*, 1945, **33**, A, Pt. 8, 238-239.) In preliminary tests pyrethrum in aerosol form proved toxic to the larvae.

Life History and Control of the Cabbage Seed-Pod Weevil (*Ceutorhynchus assimilis*) in Western Washington. By R. L. Webster. *Ann. Rep. Wash. Agric. Exp. Sta.*, 1943-44, (*Bull. No.* 455), p. 37. The material of greatest promise is a concentrated pyrethrum dust.

Development of a Powder Treatment for the Control of Lice attacking Man. By R. C. Bushland *et al.* *J. Parasitol.*, 1944, **30**, No. 6, 377-387. (*Exp. Sta. Rec.*, 1945, **93**, No. 1, 63.) MYL formula—pyrethrum the toxicant used.

Effect of Potassium Fluoride and Pyrethrum on *Periplaneta americana* L. after Hemocytes are blocked with Chinese Ink or Nephrocytes are stained with Trypan Blue. By E. R. McGovern, J. F. Yeager, E. L. Mayer and S. C. Munson. *Ann. Ent. Soc. Amer.*, 1944, **37**, No. 4, 414-419. (*Exp. Sta. Rec.*, 1945, **93**, No. 1, 61.)

The Treatment and Prevention of Sheep Scab and Haemosporidia of Domestic Animals by Means of Pyrethrum Preparations. *Veterinariya, Moscow*, 1945, **22**, No. 1, 24-27. (*R.A.E.*, 1945, **33**, B, Pt. 8, 118-119.)

La Plaga de *Sphaeroderma rubidum* (Graells) en los alcachofales de Valencia. By F. Gomez-Clemente. *Bol. Pat. Veg. Ent. Agric.*, 1943, **11**, 259-282. (*R.A.E.*, 1945, **33**, A, Pt. 6, 168.) Pyrethrum spray gave complete control of this pest of artichokes : sprays of nicotine less effective.

Laboratory Tests with New Compounds as Insecticides against the Pea Aphid (*Macrosiphum pisi*). By J. E. Dudley, T. E. Bronson and F. H. Harries. E-651, *U.S. Dep. Agric., Bur. Entomol.*, 1945. Promising results were obtained with ground yam bean (*Pachyrhizus erosus*).

Some Pioneer Work on Protection against Body Lice by the Use of Lasting Insecticides. By J. R. Busvine. *Bull. Ent. Res.*, 1945, **36**, Pt. 1, 23-32. Pyrethrum among the insecticides tested.

Evaluation of Materials for Louse Control. By M. Aschner and J. Mager. *Ann. Appl. Biol.*, 1945, **32**, No. 2, 143-148. A pyrethrum extract containing isobutyl undecylenamide as an activator among the preparations tested.

Field Experiments with Pyrethrin-Extract Emulsion as a Larvicide. By B. I. Kraev. *Med. Parasitol., Moscow*, 1943, **12**, No. 3, 84-85. (*Amer. Chem. Absts.*, 1945, **39**, No. [illegible]5, 3388.)

Mode of Entry of Contact Insecticides. By W. H. Potts and F. L. Vanderplank. *Nature*, 1945, **156**, No. 3952, 112. Experiments being carried out by the Department of Tsetse Research in Tanganyika suggest that certain insecticides (DDT and pyrethrum) need not necessarily be applied in such a way as to bring about either penetration of the general body cuticle on a large scale or entry through the spiracles, but that their action through contact of the feet alone may be effective.

The Analysis of DDT and Pyrethrins in Kerosene-based Sprays. By R. F. Powning. *J. Coun. Sci. Industr. Res. Aust.*, 1945, **18**, No. [illegible], 121-123.

Effect of Temperatures on Knockdown and Kill of Houseflies Exposed to DDT. By A. W. Lindquist, H. G. Wilson, H. O. Schroeder and A. H. Madden. *J. Econ. Ent.*, 1945, **38**, No. 2, 261-264. Comparative tests with pyrethrum were carried out.

DDT and Pyrethrum Aerosols to Control Mosquitoes and Houseflies under Semi-Practical Conditions. By A. W. Lindquist, B. V. Travis, *et al.* *J. Econ. Ent.*, 1945, **38**, No. 2, 255-257.

DDT to Control Corn Flea Beetle on Sweet Corn and Potato Leafhopper on Alfalfa and Peanuts. By F. W. Poos. *J. Econ. Ent.*, 1945, **38**, No. 2, 197-199. Comparison made with results obtained with a pyrethrum-sulphur dust.

Residual Action of DDT Aerosols against Houseflies. By H. O. Schroeder, A. H. Madden, H. G. Wilson and A. W. Lindquist. *J. Econ. Ent.*, 1945, **38**, No. 2, 277-278. Gives comparisons with pyrethrin-containing aerosols.

Concentrated Insecticides. Preliminary Studies of the Use of Concentrated Sprays against Houseflies and Mosquitoes. By A. W. Lindquist, H. O. Schroeder and E. F. Knipling. *Soap*, 1945, **21**, No. 7, 109-113, 119. DDT and pyrethrum were used for the tests.

Purification of Pyrethrum Extract. U.S. Pat. No. 2,372,183. *Amer. Chem. Absts.*, 1945, **39**, No. 16, 3620.

Stabilization of Pyrethrum Preparations. U.S. Pat. No. 2,375,773. *Amer. Chem. Absts.*, 1945, **39**, No. 16, 3618. A preparation is made containing pyrethrum, starch and inorganic salts.

Odourless Household Fly Spray. *Mfg. Chem.*, 1945, **16**, No. 7, 262. Pyrethrum and nitromethane used and spray applied by means of aerosol " bombs."

Brazilian Pyrethrum. *Chem. Tr. J.*, 1945, **116**, No. 3032, 714. Brazil to endeavour to retain its war-developed trade.

Pyrethrum in Mexico and Central America. *Chem. Age*, 1945, **53**, No. 1362, III. Planting to be encouraged in these countries.

Kenya Pyrethrum Production. *Chem. Age*, 1945, **52**, No. 1357, 575.

Pyrethrum Crop Increased in Peru. *Pharm. J.*, 1945, **155**, No. 4263, 29.

Pyrethrum Control Orders Revoked. *Chem. and Drugg.*, 1945, **144**, No. 3425, 313.

Insecticide. U.S. Pat. No. 2,362,128. *Amer. Chem. Absts.*, 1945, **39**, No. 11, 2376. A synthetic organic compound as active ingredient. May also contain pyrethrum.

OTHER INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

Cat Willow : A Study of the Insecticidal Value of the Cat Willow (*Amorpha fruticosa* L.). By C. H. Brett. *Chemurg. Digest.* 1944, **3**, No. 21, 313-314. (*Exp. Sta. Rec.*, 1945, **93**, No. 2, 166-167.)

An Amide Possessing Insecticidal Properties from the Roots of *Erigeron affinis* DC. By F. Acree, M. Jacobson and H. L. Haller. *J. Org. Chem.*, 1945, **10**, No. 3, 236-242.

Control of the Squash Bug (*Anasa tristis*) in Eastern Washington. By R. D. Eichmann. *Ann. Rep. Wash. Agric. Exp. Sta.*, 1943-44, (*Bull. No.* 455), p. 36. Sabadilla tested.

Comparative Values of New Insecticides for Use against *Lygus* spp. and the Say Stinkbug (*Chlorochroa Sayi*). By O. A. Hills and K. B. McKinney. E-648, *U.S. Dep. Agric. Bur. Entomol.*, 1945. (*Amer. Chem. Absts.*, 1945, **39**, No. 14, 3111.) Some insecticidal value indicated for sabadilla against *Lygus* spp.

BOOK REVIEWS

Books for review should be addressed to " The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

SUGAR CANE HANDBOOK. A Manual for Cane Sugar Manufacturers and Their Chemists. By the late Guilford L. Spencer, D.Sc., and George P. Meade, B.Sc., Ch.E. Eighth Edition. Pp. xiv+834, 8½ × 5½. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1945.) Price 45*s*.

The eighth edition of this work, the previous edition of which was reviewed in this BULLETIN (1930, **28**, 107), has now become a book of reference rather than a handbook. That this has been realised is evident from the fact that the word " manual " has been substituted for " handbook " on the title page of the present edition.

A comparison of the two editions reveals the large amount of information which has become available since 1930, necessitating a considerable rewriting of the text. For example, in the first section of the book, which is devoted to the manufacturing processes, the chapter on juice purification has been almost entirely rewritten, chapter 11 on pan boiling has been greatly expanded and there is an entirely new chapter on crystallisation in motion. Other sections which have been considerably expanded deal with the composition of cane and its products, vegetable carbon processes in refining, industrial uses of bagasse and warehousing of sugar.

In the second section, which is devoted to sugar analysis and chemical control of the factory, the text has been revised to conform to the latest recommendations of the International Commission for Uniform Methods of Sugar Analysis, the International Society of Sugar Cane Technologists, the U.S. Bureau of Standards and other recognised authorities. A separate chapter is now devoted to the examination of refined sugars, a section on turbidity has been added to the chapter on colour determination, and the sections on conductivity methods for ash determination and potentiometric methods for *p*H control have been considerably expanded. The reference tables which form the final section of this manual have been revised to meet present-day requirements.

This edition, with its fund of information, its excellent drawings and photographs, will be invaluable to all cane sugar technologists.

H. E. C.

FLOUR MILLING. By J. F. Lockwood. Pp. 511, 8½ × 5½. (Liverpool: The Northern Publishing Co., Ltd., 1945.) Price 25*s*.

This book is a noteworthy product of the renowned firm of Henry Simon, Ltd., of Cheadle Heath, Manchester. The author, who is head of the company's milling business, has set out "to give a complete and up-to-date description of all processes of flour milling from the reception of the wheat to the despatch of finished products." His object has been to provide a work suitable both for the student and the practical miller. Mr. Lockwood seems to have achieved no mean success in his task, and certainly the student should be more than satisfied. One would hesitate to attempt to forecast the reaction of the practical miller, though this much may be said that the book increases the respect of the outsider for his art, and for the ingenuity of the milling engineer. However, the intimation within a few months of publication that the first printing had been exhausted suggests that this study has met with the reception it so definitely appears to merit.

Following a brief introductory section in which the whole subject is outlined, the work is divided into three parts of which the first two comprise the bulk of the matter, each extending to some 200 pages. Part one deals with the reception and storage of the wheat, and the machines and processes for cleaning it and preparing it for milling. The second part describes the machines and processes for milling the wheat into flour and by-products, and the handling and storage of the finished material. In part three, which occupies comparatively little space, matters relating to management are discussed.

Mr. Lockwood has produced a careful and detailed study of his subject. A criticism offered with some diffidence by the non-expert is that the matter in a number of the later chapters seems to have received rather less complete treatment than has been generally accorded in earlier sections. Most impressive and enthralling is the record of the elaborate processes through which the material passes in the modern mill. An essential feature of the milling industry is that the mill engineer must provide for a succession of separations, many of which are difficult to achieve. Much of the matter is naturally technical, but the explanations are clear and concise. Moreover, the general style is a very readable one, and the method of presentation maintains interest. Those outside the industry, who require to know something of its processes, will find this work very informative.

The book is most amply provided with good illustrations, and the way these are employed is an excellent feature. The illustrations are generally lettered or numbered so that the process or sequence of operation can be fully explained in the text, or followed in the diagram. However, in respect of figure 57, the usual textual explanation of the lettering appears to be lacking.

The author is at pains to acknowledge the assistance of his many collaborators, without whose help a comprehensive work of this magnitude could hardly be achieved. Moreover, as Sir Ernest Simon states in his foreword, the book "embodies experience gained by the technical staff of the firm in all parts of the world during the past 70 years." Such an authoritative study as this book represents of the science of his profession by a leading industrialist is most welcome. It is only fair to mention Mr. Anthony Simon, who has acted as assistant author, and appropriate to congratulate the Board of Henry Simon Ltd. on their decision to grant permission for publication.

E. H. G. S.

A MONOGRAPH OF THE BEETLES ASSOCIATED WITH STORED PRODUCTS. Volume I. By H. E. Hinton, Ph.D. Pp. viii + 443, 9¾ × 7¼. (London: British Museum (Natural History), 1945.) Price 30*s*.

This volume represents a highly valuable war effort on the part of Dr. Hinton, Assistant Keeper in the Department of Entomology at the Natural History Museum. It was started in 1940 at the request of the Department of Scientific and Industrial Research, to meet the need for a comprehensive and systematic overhaul of the pests of stored products in connection with the introduction of greater precision in the methods of insect control. The author has supplemented his descriptions of the species by summarising published information on their biology. References are given to papers on control measures, but no attempt has been made to discuss them, as the study of commercial insect control is outside the scope of this volume. There are 26 pages of references and an index.

J. R. F.

FURTHER WORK ON PLANT INJECTION FOR DIAGNOSTIC AND CURATIVE PURPOSES. By W. A. Roach and W. O. Roberts. Imperial Bureau of Horticulture and Plantation Crops, Technical Communication No. 16. Pp. 12, 9¾ × 7¼. (Imperial Agricultural Bureaux, Central Sales Branch, Penglais, Aberystwyth, 1945.) Price 1*s*. 6*d*.

This paper deals with developments in the technique of plant injections since the publication of the previous paper on the subject by W. A. Roach in 1938 (*Tech. Comm. No.* 10). For diagnostic purposes, there are two important methods, interveinal injection and leaf stalk injection. An interesting modification in the method of interveinal injection is the replacement of the glass cups by light cellophane ones, the consequent reduction in weight giving the apparatus increased resistance to wind. The cups are made by a quick and simple process from cellophane drinking " straws " ; this method allows standardised cups to be turned out in large numbers. Coloured " straws " are obtainable and cups made from " straws " of a distinctive colour are kept for a particular solution and can be used repeatedly without washing.

The other method of diagnostic injection has been applied to a number of commonly cultivated plants, and the authors briefly summarise results obtained by the leaf stalk injection method in this country and South Africa with suggestions as to the better method of diagnosis.

As regards injection for curative purposes, the technique of solid injection has been further advanced. A suitable hole is bored in the tree into which is introduced the solid material in tablet form and finally sealed in with a cork. If the hole is cleanly cut and tightly sealed, healing occurs rapidly. It is said that a hole cut in winter or early spring becomes almost invisible by the next autumn.

The paper contains a number of excellent diagrams which clearly illustrate the methods discussed, and a short list of references is given.

I. C. S.

PROVENDER MILLING. By J. F. Lockwood. Second Edition. Pp. 372, 8½ × 5½. (Liverpool: The Northern Publishing Co., Ltd., 1945.) Price 15*s*.

Provender milling concerns the commercial preparation of animal feeding stuffs, an important industry with a wide range of products. Not only does the provender miller prepare a variety of straight meals from cereals, legumes, etc., but much of his output is now in the form of balanced rations, that is, suitably blended products designed to meet the requirements of particular classes of livestock, and to contain the nutrients required in the proper proportions. This book originally appeared in 1939, but shortly after publication the stock of unsold copies was lost by enemy action. It has now been found possible to reprint it with a few minor alterations and corrections to form this second edition. The war prevented any major developments in technique such as would have necessitated a more complete revision of the text.

The matter is considered in three sections which are of approximately equal length. The first section is introductory and includes particulars of the raw materials commonly employed, and their properties, with discussion of nutritional questions. The tables of

"Composition and Nutritive Value of Feeding Stuffs" that appear in Bulletin 48 of the Ministry of Agriculture and Fisheries, are reprinted, and an extensive summary is provided of the "Fertilisers and Feeding Stuffs Act 1926." Chapter 9, for instance, owes a good deal to the above Bulletin.

The machinery used in the up-to-date provender mill is dealt with in Section 2, including handling and cleaning equipment, grinders, sieving and dressing machines, mixers, and the special plant necessary for the manufacture of the different products.

Section 3 is concerned with the actual manufacturing processes, and includes a chapter on the manufacture of materials such as oil cake, dried grass and meat meal which are employed in the provender mill though not actually made there. The manufacture in the provender mill of a wide range of products is described, e.g. barley meal, maize meal, Sussex ground oats, cut maize and cut wheat, kibbled beans and peas, flaked maize. Chapters are provided on the manufacture of balanced rations, and of compressed foods such as cubes and pellets which are widely employed and are of considerable convenience in animal feeding. Such questions as packing and storage, the lay-out of typical provender mills, management, and production costs, also receive consideration.

Altogether this is a very useful book, and it is extremely well illustrated. The first few chapters do, however, appear to be a little elementary. In Chapter 1 the author does not always seem to be quite consistent in the use of the word "variety." It would appear to be preferable to retain this term for individually named varieties, e.g. in respect of the barleys on page 20, for Plumage-Archer, Spratt-Archer, etc., and to refer to six-row and two-row barleys as "types" or some other suitable designation.

E. H. G. S.

NOTES ON SOME GOLD COAST TREES. Compiled by D. Kinloch, B.Sc. (For.), (Edin.), Assistant Conservator of Forests, and edited by R. C. Marshall, C.B.E., B.Sc., M.A. (Oxon.), Dip. For., Chief Conservator of Forests. Pp. x + 70, 8½ × 5½. (Accra: Government Printing Department, 1945.) Price 2*s.* 6*d.*

This publication has been compiled from notes supplied by Forest Officers and Forest Rangers, departmental records, and a perusal of relevant literature. It forms a companion volume to "Gold Coast Timbers," which was published in 1941 (see this BULLETIN, 1942, **40**, 35). Whereas the earlier book dealt with the properties of timbers from the Gold Coast, the present one, on the other hand, is devoted to sylvicultural notes of some of the more important trees. In the introduction by Captain Marshall a brief description is given of the forests occurring in the Gold Coast and certain sylvicultural properties are indicated of many of those trees which have economic importance. Such information is considered essential in order to determine what sylvicultural system will be most suitable for adoption in this Colony where sylviculture is still in its early stages. In some cases, it may be found that natural regeneration will be best while in others artificial regeneration, possibly combined with the cultivation of food crops, may be preferable.

The greater portion of this book is devoted to sylvicultural notes of some 28 trees. The notes for each tree are usually classified in the same way. They deal with a description of the tree, its distribution, habitat and growth; the leaves, flowers and fruits; the power of germination and growth of seedlings; light requirements; ease of transplanting; liability to disease; and how it is best regenerated.

This publication contains in a condensed form a lot of information which must prove of interest and value to all those who are engaged in sylvicultural work in the Gold Coast or elsewhere.

G. T. B.

BEHOLD OUR GREEN MANSIONS. A Book About American Forests. By Richard H. D. Boerker. Pp. xv + 313, 9 × 6. (Chapel Hill: The University of North Carolina Press; London: Humphrey Milford; Oxford University Press, 1945.) Price 24*s*.

This book although concerned with forests of North America is of great general interest to the scientist and general reader alike as it deals with a number of aspects of the subject which are very much in mind at the present time.

The author who is a naturalist and forestry expert and a well-known writer of many popular and technical articles in the United States has an intimate knowledge of America's forests and forestry and authoritative information is furnished on forest conservation and restoration, soil conservation, timber, flood control, wild life, grazing, scenic beauty, recreation, preservation and the use of timber.

In the preface he explains that wood was classified as a critical war material and the forests of the United States were called upon for a tremendous output of raw materials essential to the prosecution of the war, and shows how through past neglect of the forests—through forest fires, bad cutting of timber, and cutting down of forest lands for farming—the production of essential wood commodities for war was handicapped. It may be a surprise to some to read this and also to know the United States experienced increasing difficulty in finding high-quality timber for special uses. This book shows what is being done by means of conservation and re-afforestation to remedy this.

Facts presented on the forest in its relation to wild life, water supply, holding the soil, flood control and as a livestock range are of much interest. Especially significant is the relation between forests and water supply, for generally speaking forests conserve water and prevent the rapid run-off which causes soil erosion.

Disastrous floods are largely a man-made phenomenon and so is erosion and the choking of reservoirs with silt. Recognizing that when the soil goes civilization goes, the author shows how forests directly affect the farmer and indirectly the whole population.

The prevention and control of forest fires is a fundamental requisite for forestry and the author discusses these in an interesting way, giving a clear idea of the system of detection and fire-fighting adopted in the United States.

Re-afforestation is undertaken both by private timber companies and by the State Conservation Department and aims at restoring areas which have suffered from fires and re-foresting abandoned farm land.

The book is much enhanced by the many beautiful plates which accompany the text. The various chapters will do much to show that forestry is destined to play an increasingly important part in the national economy and the future welfare of the United States, and in fact of any country.

R. M. J.

RICE IN THE WESTERN HEMISPHERE : WARTIME DEVELOPMENTS AND POST-WAR PROBLEMS. By V. D. Wickizer. War-Peace Pamphlets, No. 7. Pp. vi + 48, 9 × 6. (California: Food Research Institute, Stanford University, 1945.) Price 50 cents.

Of all the important food grains, rice has been the only one since 1942 in short supply among the United Nations. The author in this pamphlet has reviewed the rice world situation from the years just before the outbreak of war to the middle of 1945, a few weeks before the Japanese capitulation. Whereas before Japan entered the war the three main countries exporting rice were Burma, Thailand and Indo-China, as soon as Japan conquered south-eastern Asia these sources of supply were denied to the Allied and neutral markets. As a consequence the production of rice in non-Asiatic countries had to be increased. Such increased production took place in the Western Hemisphere, particularly in the United States and Brazil, with the result that with the exception of areas in the Caribbean, the Americas as a whole have become self-sufficient in rice for the first time, although not comfortably so.

The author in the later part of his pamphlet deals with the post-war problems that will have to be faced by the rice-producing countries of the Western Hemisphere now that hostilities have ceased. The United States and Brazil are the two countries most likely to be affected seeing that during the war-years they have been exporting rice. It is envisaged that when Asiatic rice is again offered on the world's market the American product may be badly hit as the Asiatic rice will probably have the advantage of being sold at a lower price. During the war growers of rice in the Western Hemisphere have enjoyed a boom but it is feared that these times of prosperity will cease as soon as Asiatic rice comes on the market again.

G. T. B.

Spring Frost Damage in Orchards and its Possible Prevention. Imperial Bureau of Horticulture and Plantation Crops, Technical Communication, No. 15. Pp. 22, 9¾ × 7¼. (Imperial Agricultural Bureaux, Central Sales Branch, Penglais, Aberystwyth, 1945.) Price 1*s.* 6*d.*

This publication summarizes existing information relating to frost damage to orchards and its prevention. In the Foreword by Professor E. J. Salisbury, F.R.S., Director of the Royal Botanic Gardens, Kew, emphasis is placed upon the importance of this question to fruit growers as the incidence of frost may determine whether orchards are a success or not.

The Technical Communication opens with short sections on the physiological aspect of frost injury and internal and external factors affecting frost resistance. Then follows a larger section in which methods and apparatus for preventing damage are described and their value assessed. Probably the most common method of frost prevention is by orchard heating. Smoke screens and chemical mists have also been used and have proved of some value in light frosts. The present position is described later in the publication as being that, although much has been discovered, results of immediate practical value to the deciduous fruit growers have been few. Suggestions are made as regards future work to be carried out. They are grouped under the headings of meteorological, topographical and pomological. Finally further investigations are advocated on orchard heating and the production of smoke clouds. It is feared, however, that these methods of preventing frost damage in this country would prove too expensive in view of the fact that severe frosts are only encountered once in four or five years.

G. T. B.

MINERAL RESOURCES

ARTICLES

NIGERIA—GEOLOGY AND MINERAL RESOURCES[1]

By F. Dixey, O.B.E., D.Sc., F.G.S.,
Director, Geological Survey of Nigeria

Our early knowledge of the geology and mineral resources of Nigeria, like that of so many of the British Colonies in Africa, is based on the Mineral Surveys directed by the Imperial Institute in the period 1903-1913. The Mineral Survey was begun in Southern Nigeria in 1903 by Dr. John Parkinson, who was succeeded by the late Sir Albert Kitson, and in 1904 Dr. J. D. Falconer initiated the Mineral Survey of Northern Nigeria.

After the war of 1914-1918, the Geological Survey of Nigeria was established with Dr. Falconer as its first Director, assisted by Dr. R. C. Wilson, who succeeded him in 1927 and held office until his death in 1943.

From time to time the Imperial Institute has given welcome assistance to the Geological Survey in the investigation of mineral deposits and in the publication of results.

A representative collection of the minerals of Nigeria is exhibited in the galleries of the Imperial Institute; moreover, the Mineral Resources Department of the Institute has available for consultation the Annual Reports, Bulletins, maps and other publications of the Geological Survey, and it gives advice and information on the mineral resources of the country as required.

Geology and Mineral Resources

Geology

The central and western parts of Nigeria, making up about two-thirds of the country, are occupied by the Basement Complex, comprising gneisses, schists, and granites and other intrusives, and by the Younger Granites. A very long gap in the geological column is represented by the interval between these ancient formations and the next succeeding younger beds comprising sediments of Cretaceous, Tertiary and post-Tertiary age, which wrap around the older rocks to the north, east and south, and overlie them along the valleys of the Niger and the Benue.

[1] Lecture delivered on October 31st, 1945, at the Imperial Institute.

The Cretaceous sediments, largely of marine origin, comprise mainly sandstones and shales of a lower group separated, probably by an unconformity, from sandstones and shales, with included coal measures of an upper group. These are overlain, in the south and the north-west, by marine clays and sands of Tertiary age, while these are succeeded in the Chad basin by terrestrial and lacustrine sands and clays referred to the Pleistocene, and by Pleistocene and later sediments in the coastal belt. In the southern areas the Cretaceous and Tertiary sediments break down into a considerable thickness of superficial red sands originally known as the Benin Sands.

Following the intrusion of the Younger Granites we know nothing of the geological history of Nigeria until the period of uplift and erosion preceding the deposition of the basal Cretaceous beds, which in general were laid down on an uneven surface of the older rocks; thereafter until about the Eocene a large part of Nigeria was submerged by the sea, out of which the main highlands of the Jos plateau and the Cameroons probably stood up as islands.

The lower Cretaceous beds locally exhibit sharp folding, but the later Cretaceous and the Tertiary show nothing more than extremely gentle folding. Except for the extraordinary and somewhat unexpected overthrusting recently observed in the Fluvio-Volcanic Series of the Jos plateau, Nigeria does not seem to have experienced anything more than intermittent uplift and gentle warping since the lower Cretaceous, and its history in this respect seems to have been much like that of the greater part of eastern and southern Africa.

The Fluvio-Volcanic Series occurs in patches over the greater part of the Jos plateau. The beds rise in isolated hills to a maximum elevation of about 4,700 ft., and they have been denuded from all levels below about 3,600 ft. They comprise mainly tin-bearing sands and gravels at the base, succeeded by a series of clays, occasional sands, and basalts, usually weathered down to clays. They are succeeded by the later basalts, which have been erupted intermittently over a considerable period extending even to recent times; these basalts occur locally on the plateau, and in places they have flowed down the valleys on to the plains below. There are groups of young unweathered volcanic cones. Basaltic flows of late age occur also in the Cameroons, and on the coast lies Buea Mountain, a recently active volcano 13,000 ft. in height.

The Fluvio-Volcanic Series is affected by normal faults and also by thrusts that have locally carried the gneiss up over the sediments; these fractures are older than the later basalts, and they have been bevelled by the 4,300 ft. peneplain.

The age of the Fluvio-Volcanic Series is not known with certainty, but it is possible that a study of the associated erosion surfaces may throw further light on this question. It is of interest that the principal erosion surface of the plateau cuts across these beds and the underlying granite and gneiss at an elevation near 4,300 ft., and that it shows no appreciable change of level over distances of 30 miles or more. This surface has been eroded by a younger surface that descends gradually through wide gaps to the level of the great plain, 1,500 ft. below, that surrounds the plateau for scores or hundreds of miles to the west, north and east; to the south lies the Benue valley and its associated plains. Above the main plateau surface rise granite residuals bearing eroded remnants of a surface 1,000-1,200 ft. higher. High-level erosion surfaces, commencing at about 4,500 ft., cut across the rocks of the Basement Complex of the Cameroons.

In their general relationships the 4,300 ft. erosion surface, the older residuals resting upon it, and the surrounding younger surface, can be compared with the 4,000-4,500 ft. Miocene peneplain of eastern and southern Africa, the pre-Miocene residuals resting upon it, and the Pliocene surface eroded at a level 1,000 to 2,000 ft. below. If this comparison were justified, and at present there is no other evidence to support it, the Fluvio-Volcanic Series would be somewhat older than the middle or upper Miocene, and in this connexion it is of interest that the Lower Miocene Beds of East Africa, older than the main peneplain, are similarly affected by thrusts.

Mineral Resources

In 1939 the tonnage and value of the mineral exports from Nigeria were as follows:

Tin concentrates . .	*tons*	14,569	£2,445,272
*Gold bullion . . .	*oz.*	25,799	185,525
Columbite . . .	*tons*	231	21,851
Wolfram . . .	*tons*	213	34,613

* *Figures refer to production, exports not being available.*

Tin.—By far the most important mineral product in Nigeria is tin ore, which has been known since the earliest days of the Colony. It was first exported in 1905, and thereafter its production increased to 13,016 tons in 1939, and to 17,258 tons in 1944. During the period 1905-1944 the total production amounted to 350,000 tons.

Tantalite.—Tantalite was exported in 1943 and 1944 to the extent of 2 tons and 13 tons respectively. Tantalite is the source of the metal tantalum, which is used in chemical plant and in the radio industry.

Columbite.—The columbite alluvials of the Plateau are of unique interest, and they have been of especial value in relation to the war effort. Over 6,000 tons of columbite have been produced during the last ten years, and in 1944, out of a total production of 2,072 tons, the Associated Tin Mines of Nigeria obtained over 1,000 tons of the mineral by re-treating the alluvial tin-mining dumps. Recent investigations into the source of the columbite, concerning which little is known, have shown that in at least the Rukuba Hills area the mineral is disseminated in the granite, although only in very small proportions. Columbite is the source of ferro-columbium, which is used in the production of alloy steels.

Coal.—In 1939 the Enugu Colliery produced for local use 323,266 tons of coal valued at £128,866, but by the year ended March 31, 1945, the production had risen to the record figure of 668,158 tons, an excess of 139,737 tons over the previous record. During the war period considerable quantities of coal were exported to the Gold Coast for the operation of the railways.

Gold occurs mainly in the schists of the Basement Complex, and the principal gold-bearing areas are accordingly west of Gusau in Sokoto Province, in Laria Province, in eastern Niger Province, and in eastern Oyo Province.

Salt, galena (" antimony "), clays, limestone, laterite, etc., are worked for local use.

Other known mineral deposits include the lead-zinc ores, with small percentages of silver, occurring in the lower Cretaceous sediments in the south-eastern part of the country, the lignite of the later Tertiary sediments of Southern Nigeria and minor occurrences of rutile, beryl, monazite, phosphate, fluorspar, bitumen, etc. Diamonds also have been found in northern Nigeria, but the area has been closed to prospecting and little is known of the occurrence.

Investigations have shown that cement of excellent quality could be made from certain extensive deposits of limestone, clay, shale, etc., occurring in the sedimentary formations, but that owing to a number of factors locally-produced cement could not compete in price with imported cement.

Prior to the war the Anglo-Iranian and Shell Groups jointly made careful search for oil in the southern part of the country north of Port Harcourt. The result of this investigation has not yet been made known, but in view of the occurrence in this area of a great thickness of gently-folded Cretaceous and Tertiary sediments of marine and shallow water origin it was reasonable to suspect the presence of oil, although it need not necessarily be present in commercial quantities. The investigation was interrupted by the war and is to be resumed in due course.

Water Supply

During the period 1928-1939 the Water-Supply Section of the Geological Survey constructed 1,350 concrete-lined dug wells ranging up to 300 ft. or more in depth. These wells were required, mainly in the Northern Provinces, in order to replace inadequate or polluted supplies in native areas, both for village use and for cattle, and to combat particularly the scourge of guinea worm, which at certain times of the year incapacitates a large proportion of the population of numerous villages.

Many of the Geological Survey wells replaced native wells that were falling into disuse owing to the unstable nature of the ground ;

these wells were sometimes lined with cut timber or with brushwood, but often they were unlined, and consequently they generally remained in use for a few years only before collapsing. They were of narrow diameter, 2 to 3 ft., and of remarkable depth, sometimes approaching or exceeding 400 ft.; they were thus, I believe, the deepest native-dug wells in any British or other colony in Africa. Where no other supplies are available well-sinking of this kind is still carried on. The scenes around the deep wells in the Lake Chad country, with teams of men and women drawing water day and night for innumerable stock of all kinds, are reminiscent of the famous well-fields of Wajir, El Wah and elsewhere in the arid lands of Northern Kenya.

For several years prior to the war the Geological Survey had carried out a little water-boring with the aid of one drill. The work was generally successful, but slow and expensive, since all the areas approved for drilling, in the south-west, north-east, and north, were underlain by fine-grained unconsolidated sediments of great but unknown depth; these sediments presented very difficult problems both in the drilling operations themselves and in the screening of the sediments when water was found. The drilling was carried down to a maximum depth of 800 ft.

A strongly-flowing artesian bore-hole occurs at the crossing of the Oji River by the Enugu-Onitsha road in Southern Nigeria; the water comes from a thick sandstone in the lower Coal Measures, of Upper Cretaceous age, but it has no value locally as a water supply since that part of the country is naturally well watered. In the arid Chad basin, where artesian supplies would be invaluable, water has risen in the Maiduguri aerodrome bore-hole from a depth of 735 ft. to 30 ft. from the surface, as described on page 309.

WAR-TIME DEVELOPMENT AND POST-WAR PLANS

On the outbreak of war the small remaining Geological Survey staff concentrated its activities on the investigation of mineral deposits required for war purposes. Most of the Water-Supply staff, European and African, and their equipment, were immediately requisitioned for military water-supply construction, at first in Nigeria and later farther afield. The experience gained by the staff in pre-war years proved of great value in their new military work, which they have carried out with distinction in East Africa and in Burma. Civil well-sinking in Nigeria was continued on a small scale where required indirectly for war purposes, as for health, labour and production, and towards the end of the war this side of the Departmental work increased as European staff became released from military service.

The Geological staff, in association with the Mines Department, assisted in the production of tin, tantalite, columbite, and wolfram, by investigating known deposits and by searching for new ones; this work has been described in the Annual Reports of the Department and in supplementary reports. The work on wolfram ceased in 1943 when the demand for this mineral diminished, and the production of tantalite similarly ceased early in 1945. A point of minor scientific interest, arising from the investigation of the tin-tantalite-pegmatites by R. R. E. Jacobson and J. S. Webb, is the discovery of a new tin-zinc mineral which is still in course of examination.

The production of gold continued on a small scale, but an expansion of this section of the mineral industry is anticipated in the post-war years. The gold recovered so far has been mainly alluvial, and this source is likely to remain important for some time. In the southern goldfields the forest cover is very dense, so that in these areas prospecting for reefs is necessarily slow and difficult, but more systematic search for the source of the gold will doubtless be required in the near future.

The annual production of coal was more than doubled during the war period, as shown on p. 303. Much attention has recently been given to the question of extending the use of the coal and its by-products.

Tin.—After the loss of the Malayan tin mines, Nigeria became in 1942 the Empire's leading tin producer, and every possible effort was made to increase production, and the extent to which this was achieved is shown by the following figures of annual output :

	1939	1940	1941	1942	1943	1944
Tin ore (*long tons*)	13,016	16,568	16,638	17,107	17,463	17,258

For taxation purposes this ore is assumed to be 75·5 per cent. Sn, but actually was nearer 73·5 per cent.

The Geological Survey examined the tin-bearing pegmatites outside the main Jos tin-producing area for new sources of supply.

It may be added that a new Mining Law has recently been passed for the regulation of the mining industry of Nigeria.

The Plateau Tinfield

On the Jos plateau, where for years the tin had been obtained essentially from the modern stream-beds and the younger stream terraces, some apprehension was being felt as to the future of an industry based on these deposits. Similar but much older deposits had been observed locally in the basal beds of the Fluvio-Volcanic Series, and it was rightly considered that a thorough examination of these beds, as well as of the gravels underlying the later basalts, was called for with a view to finding new deposits. The Geological Survey took up the enquiry, and, a little later, with the assistance of a grant of £30,000 from the Colonial Development and Welfare Fund, the work of revising the geological mapping of the plateau tinfield was commenced.

The re-mapping of the tinfield, with special reference to the search for new tin deposits, was commenced in September 1944 ;

by the end of June 1945, a considerable area south of Bukuru had been re-surveyed, and an interim report on the results of this work has recently been issued for local use.

Some minor lodes, disseminations and eluvial deposits are known on the plateau; they are not at present of any great importance, but deposits of this kind associated with the Younger Granites both of the plateau and of other areas are being carefully investigated.

Since all the more important tin deposits of the plateau are alluvial, either modern or ancient, it follows that the search for new deposits involves careful study of the erosion history of the plateau. Such study indicates that the stream courses underlying the Fluvio-Volcanic Series belong to a system very different from that of the modern streams; remnants of these older courses intersect the modern valleys at all angles, and they may occur on the plateau surface and on the broad grassy watersheds at a considerable distance from the main valleys. For this reason the tin workings tend to creep up the slopes of the modern valleys more and more and not infrequently even to reach the main watersheds themselves. Under war conditions it has proved economic to mine the tin deposits in open workings, either by hand or mechanically, under an overburden of as much as 100 ft.; this overburden often consists in large part of Fluvio-Volcanic beds. The great mechanical excavators and drag-lines are run electrically from hydro-electric power developed on the Kurra River as it descends the southern escarpment of the plateau on its way to join the Benue.

The upland areas of the plateau, comprising mainly rolling grassland with occasional low rocky granite hills, were originally overlain to considerable depth by the Fluvio-Volcanic Series, and subsequent erosion has in many cases left only thin patches of these beds resting on the older rocks of the watersheds; these patches are potentially important since any tin present in the deposits is usually confined to the lowest few feet. Careful search should accordingly be made for such high-level residual deposits. It follows, too, that where the Fluvio-Volcanic deposits form low residual hills on the plateau there is little if any prospect of finding tin within the hills themselves, and that search should be made for the base of the deposits near or below the foot of the hills. Such hills may overlie ancient eluvial or terrace deposits even if no main lead is present.

The deep leads underlying the Fluvio-Volcanic Series and the later basalts are likely to become of increasing importance to the industry. A principal object of the present re-mapping is to try to indicate the extent and character of these deposits. Some success has already been gained in this direction, but it has to be borne in mind that even when the points of entry and exit of a deep lead beneath the overlying deposits have been found, there is still in general no way of tracing the course of the intervening meanders except by shaft-sinking or drilling; they may be determinable by geophysical prospecting, but even then the drilling and pitting would be necessary for the sampling.

The question of deep leads under the later basalts deserves more attention than it has sometimes received. In the first place it has to be remembered that the basalt lavas erupted at any point on the plateau necessarily flowed into the stream courses existing at that time and thus buried any tin that may have been present; the larger flows are clearly more likely to have reached the main streams and the more important deposits. But the exact position of these early stream courses is often by no means obvious, for the basalt flows necessarily diverted the early streams to a greater or less extent and frequently into entirely different routes. For example, many cases can be quoted in which the basalt flow ran down the valley, solidified, and thereby caused the original stream to take up a new course along one or both edges of the basalt flow; the new stream course or courses soon cut down to bed rock. Such streams have in many cases been examined for tin, which, owing to their short life, they would be unlikely to contain; it has not always been realised that the main and original stream would follow a more or less parallel and deeper course beneath the basalt. In some cases, owing to the great depth to which the new valleys have been eroded, the basalt, originally occupying the floor of a valley, now stands up as a plateau bounded by valleys of greater or less depth; yet it is under the plateau and not along the valleys that the tin should be sought.

There remains the question of the effect of thrust-faults on the working of the tin. This probably does not affect any large part of the plateau tinfield, but the fact remains that, in at least one area, the gneiss has been thrust up over the Fluvio-Volcanic Series on a plane of moderate dip, with the extraordinary result that the tin underlying these deposits has to be worked under or through a considerable thickness of the gneiss. Thrusts and normal faults are known to exist in other parts of the plateau, and it is advisable to be on the alert for these structures, and to consider their effect on mining operations.

It follows from the considerations already set forth that what is required in order to prolong the life of the tin-mining industry of the plateau is not only a thorough search for deep leads, on the lines indicated, in the areas occupied by the Fluvio-Volcanic Series and the later basalts, but also the systematic examination of the grassy uplands for the basal tin-bearing deposits of the Fluvio-Volcanic Series and for eluvial tin. The probability that in some cases the overburden will prove too great to permit of economic working should not be allowed to impede this necessary exploration, since it is equally likely that in many other areas economic working will be possible.

In the course of the present survey of the plateau tinfield a very large number of old and new tin workings have been examined, and much useful information regarding them has been given by the mining companies. Many requests for information on the geological aspects of the operations have been dealt with, and numerous samples and concentrates have been examined and reported on; it is desired to continue to assist in this direction as required in the course of the survey.

The Geological Survey and the Mining Industry

Shortly after his arrival in Nigeria in 1944, the Director of Geological Survey met the Chief Inspector of Mines and representatives of the mining community at Jos; he stated that the Geological Survey would give all possible assistance to the mining industry, and he described the re-survey of the plateau tinfield it was proposed to undertake. The mining companies were asked to co-operate in this work as fully as possible so that the results achieved would be of maximum value, both to the industry and to the country. It was proposed to publish the results of the survey in due course as a bulletin of the Geological Survey, but in the meantime progress reports would be issued for local use. The work of mineral determination being carried out for the mining community at the Mineralogical Laboratory of the Geological Survey was described.

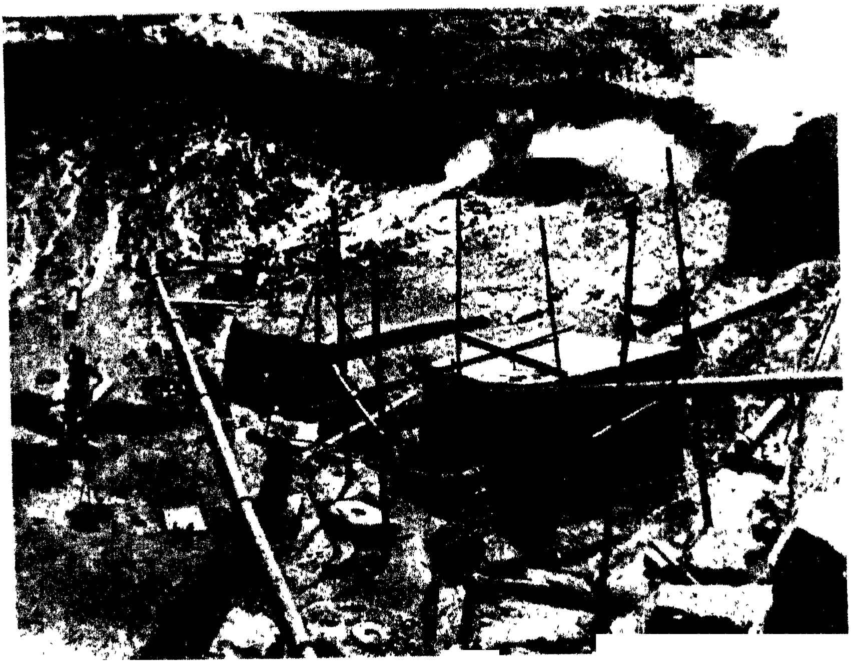
A Geological Survey branch office is to be opened at Jos, where Geological Survey bulletins, reports, maps, etc., will be available for consultation, and rocks and minerals of local interest will be displayed. Minerals and samples may be submitted to this office for examination and report, and as necessary they will be passed on to the Geological Survey Mineralogist for further investigation.

It is hoped in the near future to appoint to the Geological Survey a Mining Geologist, who will assist in the mapping of mining areas and advise on the geological aspects of mining as required.

Water Supply

Adequate supplies of good water represent Nigeria's most urgent need. In the rural areas especially the provision of new water supplies must form the foundation of all other native welfare services, such as health, education, and agriculture; it is urgently required also for purposes of administration, for native markets and other centres, and for cattle, especially along the trade routes. In most areas wells and bore-holes would form the new sources of supply. The existing rural supplies are dangerously polluted, and in addition, in the dry season people often have to walk many miles daily for a very meagre supply; these conditions lead in the aggregate to an immense loss of health, well-being, and productive capacity. Many wells have already been constructed in the native areas, but they are still urgently required in vastly greater numbers.

Plateau tin mine. The tin- and columbite-bearing gravel or "wash," shown at the lowest level beneath the overburden of Fluvio-Volcanic beds and alluvium, is removed separately and concentrated by washing.



Plateau tin mine. The tin ore is recovered from the "wash" beneath the overburden by sluicing with a powerful jet of water.

Concrete well-head at native village near Sokoto; one of 1,600 concrete-lined wells constructed by the Geological Survey. Water raised over rollers is poured into basins and led into pots and cattle troughs.

PLATE IX.

Driven-tube well in sandy alluvium at Kazaure. An abundant water-supply made available in a few hours by driving a tube and strainer down to saturated sands.

In 1943, at Maiduguri aerodrome, a bore-hole 800 ft. deep struck water in clayey gravel at 735 ft.; the water was confined beneath clays under sufficient pressure to bring it to 30 ft. from the surface, and the bore-hole has to date been pumped steadily at the rate of 1,400 galls. per hour, for 12-16 hours per day, although the maximum yield is considerably greater. The water is of good quality. This has proved a most valuable supply in a very dry area, and it probably indicates the presence of important supplies of water under pressure within the Chad basin. As soon as staff and supply conditions permit it is proposed to carry out a drilling investigation into the water resources of this basin.

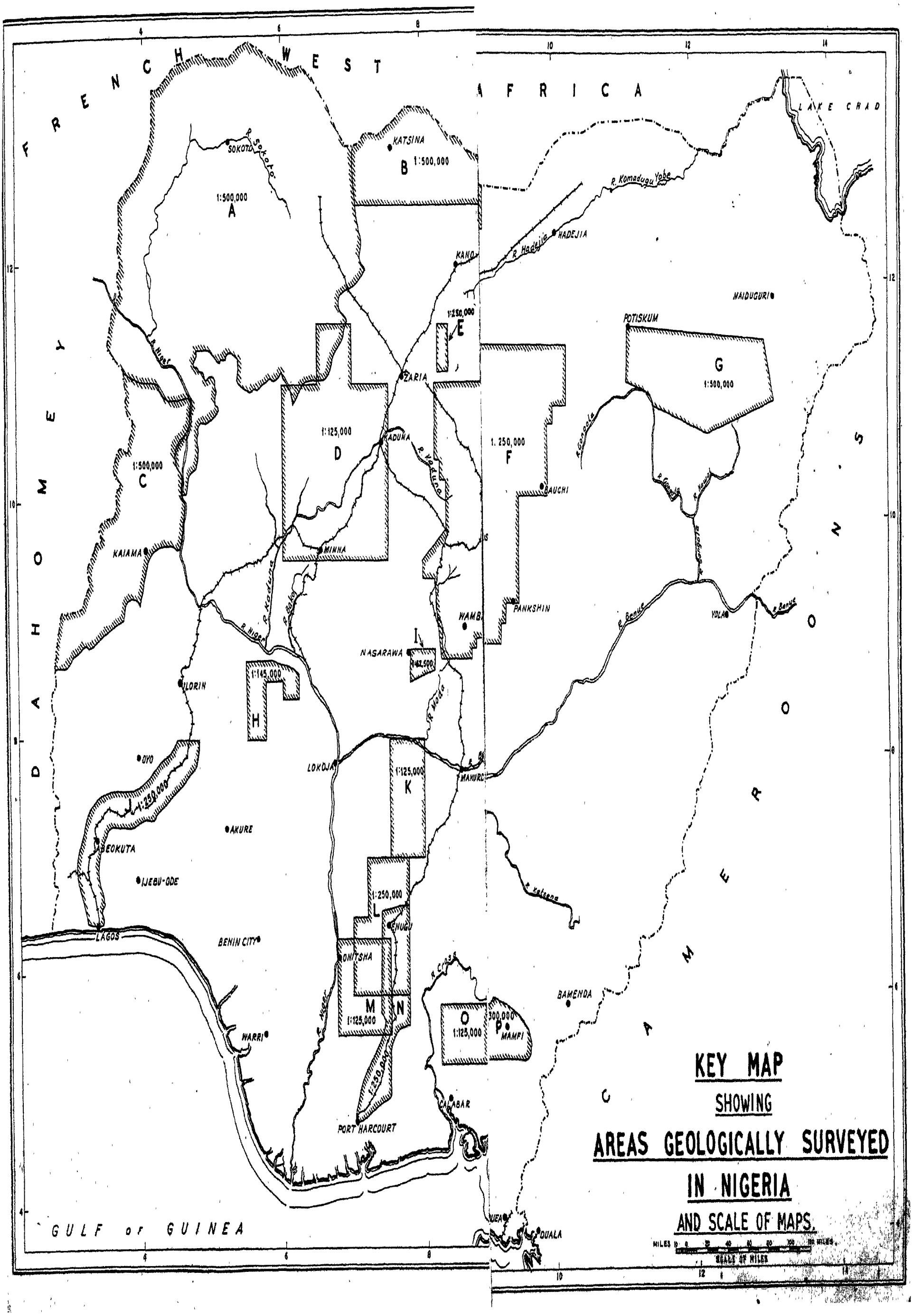
Towards the end of 1944 the Director of Geological Survey prepared a scheme for the improvement of rural water supplies as part of the general plan of Colonial Development and Welfare in Nigeria. This scheme provided for the construction of a large number of new concrete-lined wells of the type successfully introduced by the Geological Survey in recent years, and for a considerable expansion of the water-boring programme, so that bore-holes of moderate depth, fitted with hand-pumps or with simple power-pump and tank installations could be put down where dug wells were impracticable owing to great depth to water or to the hardness or instability of the rocks. Proposals for the maintenance of these works were also made. This scheme for the improvement of rural water supplies was approved, and a sum of £1,889,000 covering the first five full years of operation has been granted.

Post-War Activities of the Geological Survey

For some years past, including the war period, the Geological Survey has laboured under great difficulties and restrictions, largely owing to shortage of staff. During the war, activities have, of course, been concentrated on the investigation and development of minerals required for war purposes, and some useful results have been achieved; for several years prior to the war efforts were devoted mainly to the development of water supplies, and it was not possible to achieve marked progress in other directions.

Towards the end of the European War, however, it became apparent that if the Geological Survey was to take its rightful place in the investigation and development of Nigeria's mineral resources it would require to be very considerably strengthened, and it is very satisfactory to be able to record that official support for this view was readily given. Furthermore, a scheme for the reorganization of the Colonial Geological Surveys on a regional basis is at present under consideration, and it is possible that further assistance will be received in this direction, as in provision for specialist advice and for interchange of visits and of information between the respective Geological Surveys.

The approved strength of the geological side of the Geological



KEY MAP
SHOWING
AREAS GEOLOGICALLY SURVEYED
IN NIGERIA
AND SCALE OF MAPS.

necessarily be given to current requirements, such as advice on the geology of actual mining operations, the investigation of new discoveries, the search for road metals and rail ballast, the examination of bridge and dam foundations, and advice on soils, building materials, water supplies, etc.

The Geological Survey has accordingly to take its place in a comprehensive plan of Colonial development, and it is fortunate in having received substantial official help for this important task.

In conclusion, I should like to express my indebtedness to Sir Harry Lindsay, K.C.I.E., C.B.E., Director of the Imperial Institute, and his staff, for kindly affording me every facility in the preparation of this paper.

AREAS GEOLOGICALLY SURVEYED AS SHOWN ON KEY MAP

Key Letter.	*Scale.*	*Title.*	*Date of Survey.*
A*	1 : 500,000	Sokoto Province	1927-40
B*	1 : 500,000	Katsina and Daura Emirates	1933
C*	1 : 500,000	Borgu Division, Ilorin Province	1935-36
D*	1 : 125,000	Nigerian Goldfield	1930-37
E	1 : 250,000	Faiki Area	1926
F	1 : 250,000	Tinfields of Nigeria	1920-27
G	1 : 500,000	Southern Bornu	1931
H*	1 : 125,000	Kabba-Ilorin Pegmatite Areas	1940-45
I	1 : 62,500	Afu Hills	1943
J	1 : 250,000	The Western Railway	1919-21
K	1 : 125,000	Coalfield, Section 3, Ankpa Area	1930
L	1 : 250,000	Coalfield, Enugu Escarpment Area	1943
M	1 : 125,000	Onitsha and Owerri Provinces	1927
N	1 : 250,000	Eastern Railway	1924
O	1 : 125,000	Calabar Tinfield	1926
P	1 : 300,000	Part of Mamfe Division	1925

* *Unpublished.*

In the absence of MR. CREECH JONES, Parliamentary Under Secretary of State for the Colonies, the Chair was taken at short notice by SIR WILLIAM MCLEAN, K.B.E., Ph.D., M.Inst.C.E.

In introducing the lecturer the **Chairman** apologised for the unavoidable absence of Mr. Creech Jones. He emphasised the fundamental importance of a knowledge of mineral resources to all forms of development and planning in the Colonial Empire and congratulated Sir Harry Lindsay and Mr. S. J. Johnstone on having arranged for this new series of lectures at the Imperial Institute on the geology and mineral resources of various Colonial territories. He outlined Dr. Dixey's career in the Colonial Geological Service, which commenced in Sierra Leone in 1918, was carried on later in Nyasaland and Northern Rhodesia, and had now brought him back to West Africa. Sir William laid stress on the lecturer's experience and knowledge of water supply problems in tropical Africa.

Dr. Dixey then delivered his lecture to an audience of about 100.

DISCUSSION

Sir Edmund Teale expressed his pleasure at being present and referred to his very early association with the Mineral Survey of Nigeria. He thought it most appropriate that these lectures should have been arranged at the Imperial Institute and that the first should have been devoted to Nigeria, for it was about forty years ago that the Imperial Institute organised the Mineral Surveys of various African territories, beginning with Nigeria. This was the pioneer work from which later developments followed. It was the business of the geologist in the field to explore the mineral deposits of a country, but in regard to their applications, both locally and for export, which are continually expanding and changing, the geologist in the field could not be expected to keep in close touch with the latest developments. It was here that the Imperial Institute came into the picture with great importance in the past and should do so to an increasing extent in the future. On the chemical side there were sometimes analyses and examinations to be done which could not be carried out in the less elaborately equipped laboratories of a Colonial Geological Survey, and there were other factors in relation to the technical treatment of minerals and other economic considerations in which the Imperial Institute is able to provide valuable information. It was also a great help to the geologists to make contact with this important centre of information on mineral resources.

The speaker was particularly interested in this lecture, as it was in Nigeria that he himself started his geological work, and he was greatly interested to learn of the developments which had subsequently taken place.

Sir Bernard Bourdillon congratulated Dr. Dixey on the way in which he had made a talk on a very highly technical subject interesting even to a layman. He would like to underline the Chairman's opening remarks and emphasise the general importance of Colonial Geological Survey work. In 1939 the Colonial Development and Welfare Act was passed under which the British taxpayer would spend £120,000,000 in ten years on Colonial development and welfare. The Act put development before welfare, but he thought the average inhabitant of this country who was beginning to take an interest in the Colonies was inclined to put welfare first and to push development rather into the background. There might be reasons for this, but the speaker thought it wrong to lay too much stress on welfare and not enough on development. However sound the humanitarian view may be, and however right it is to wish to raise the standard of living of Colonial peoples, in the long run the standard can only be that which they can afford to maintain out of their own resources. We must aid in their productive development and cannot afford to push the development of material resources into the background. In the past we had not spent nearly enough on the main work which Dr. Dixey and men like him were doing. Such work is of vital importance if the standard of living in the Colonies is to be raised. Sir Bernard asked if anything had been discovered in the last year or two to cause an alteration in the estimates previously assumed as to the probable life of the tin mines of Nigeria.

Professor W. R. Jones felt sure that all would agree with the Chairman that the Imperial Institute was to be congratulated on inaugurating this series of valuable lectures. Dr. Dixey had succeeded in giving an inspiring lecture and the speaker the pleasant feeling of having listened to an authority on his subject.

When in 1911 Dr. Falconer published his very remarkable book, "The Geology and Geography of Northern Nigeria," he described the natural history of the tin deposits of that country. He showed that, owing to the covering of the alluvial tin deposits by successive outpourings of lava, followed by cycles of erosion, the drainage system of the plateau had become so changed over extensive areas that there was no longer any relationship between it and the distribution of the buried tin leads. This work of Dr. Falconer had proved of profound importance to the Empire, both in the intervening years and during the war just concluded, when we lost the tinfields of Malaya, Burma, the Netherlands East Indies, Siam and French Indo-China—a loss of 64 per cent. of the world's tin production. We turned to Nigeria to help to make up the lack of supply, and fortunately Nigeria rose to the occasion. The interesting point was that during all these years the main conclusions of Dr. Falconer still stood.

Professor Jones asked whether any new evidence had become available concerning the age of the primary tin mineralization (ignoring such tin as may possibly occur in association with the Older Granites). The tin-bearing Younger Granites of Nigeria appeared to be of Pre-Cambrian age, in which case the plateau tinfield was about the oldest tin mineralization of economic importance known in the world.

Professor Jones asked how the 5,000 sq. miles of Younger Granite had been emplaced in an area that was already solid with granite. He also asked whether there was any evidence of the reconstitution of the old granite to form part of the new granite.

Dr. G. M. Lees wished to say a word in appreciation of the work of the Geological Survey of Nigeria. Dr. Dixey had mentioned that exploration for oil in Nigeria had been carried out for some years by the Anglo-Iranian Oil and Shell Companies in combination. It had been known for many years that there were tar sands and other indications of petroleum in beds extending along the coast for a number of miles to the east of Lagos, but the beds in which they occur dip southwards under the sea. Attention was therefore turned to the possibility of finding oil in the upper part of the Niger delta area and extensive geological and geophysical surveys were carried out. So far, unfortunately, the conditions have proved to be exceptionally difficult, and no targets have been found for drilling operations. Nevertheless the work will be continued. In the course of this investigation the speaker had been very surprised that the thickness of Cretaceous sediments encountered was of the order of 15,000 ft. and that there was considerable folding. He would like to know whether Dr. Dixey had any views on the regional tectonics of this zone. The speaker wished to say how much the companies had been able to benefit from the work of the Geological Survey, and expressed the hope that the search for oil would eventually succeed, and that, if it did, it would help towards the development and welfare of Nigeria.

Wing-Commander D. C. Ion said that he had been engaged on the work referred to by Dr. Lees and wished to take this opportunity of publicly thanking the Nigerian Geological Survey for their co-operation with him while he was there. He would like to ask Dr. Dixey if he could elaborate his remarks about the Benin Sands, and also to ask if any additional information had come to light as a result of the Survey's recent investigations into the possible western extension of the Enugu coalfield.

Dr. S. Buchan wished to thank the Imperial Institute for the opportunity it had afforded him of listening to Dr. Dixey's lecture and to express his appreciation of the review that had been given of Nigerian geology and economic mineral resources. He would like to ask whether it was contemplated using Nigerian lignite as a source of power or as a source of by-products such as waxes.

Mr. J. S. Webb thought that Dr. Dixey had not mentioned the distinct difference in age between the tin deposits associated with pegmatites and those associated with the Younger Granites, and asked if the lecturer would make some remarks on this point.

Dr. F. Dixey, in reply, said he had been very interested in the comments of various speakers and in the additional information they had given. In reply to Sir Bernard Bourdillon, he was unable to say whether any new estimate of the life of the tinfields had been made, and he felt that too little was yet known of the possible extent of new deposits to say much about their ore reserves. Nevertheless, the fact that the tin-mining companies were still prepared to spend considerable sums on new dredges and other equipment showed that they were preparing to go on for quite a while. He was interested in Professor Jones's remarks on Dr. Falconer's pioneer work and agreed that there was nothing to add to his main conclusions, though he might differ somewhat in his interpretation of the movements that led to the accumulations. The ground was being re-mapped in order to gain more information about the Fluvio-Volcanics and the associated tin deposits.

The question of the age of the primary mineralization raised by Professor Jones bore also upon Mr. Webb's enquiry as to the relation between the tin associated with pegmatites and that associated with the Younger Granites. The pegmatites were for the most part at a considerable distance from the Younger Granites. Younger Granites were not known in the vicinity of the pegmatites, but Older Granites were. He could not be definite about the age of the Younger Granites. They were probably very considerably younger than the pegmatites, but what their precise age was he could not say. They were intruded in the Basement Complex, and they were certainly much older than the early Cretaceous deposits. They were not necessarily to be included in the Basement Complex, particularly in view of the fact that elsewhere in Africa granites were known as late as the early Jurassic.

As regards the Younger Granites, their relation to the Older, and mode of emplacement, it was not possible to be very definite; much more information was wanted. Dr. Dixey stressed, however, that the Younger Granites were not so much emplaced in a great mass of Older Granites as into a region of Basement Complex that contained not only Older Granites but also a wide range of schists and gneisses.

The lecturer expressed his interest in the information given by Dr. Lees regarding the Cretaceous sediments. Dr. Dixey had in fact been unaware of the very great thickness of Cretaceous sediments described, and could only add his wonder to that of Dr. Lees that so great a local thickening could have taken place. The result was of great interest and worthy of further study. He thanked Dr. Lees and his colleague, Wing-Commander Ion, for their tributes to the work done by the Survey.

As regards the Benin Sands, later work showed that the term Benin Sands had been loosely applied to a lithological facies of both the Tertiary and the Cretaceous, and even included deposits being formed now by the weathering of the underlying sediments; the term was therefore inadmissible as a formation name. Work on the western part of the coalfield had only just commenced.

In reply to Dr. Buchan, Dr. Dixey said that the recent investigation of the properties of the lignite, as distinct from the earlier one made by the Imperial Institute, was confined to minor power-raising purposes along the Niger, and that it also was still in its early stages.

In conclusion, the lecturer expressed his appreciation of the comments of the various speakers on the work of the Geological Survey of Nigeria, and to these he was glad to add his own tribute as he had only recently joined that Survey.

The Chairman remarked that they all agreed that they had had a very valuable lecture and a very valuable discussion arising therefrom, and he was sure Dr. Dixey must have been gratified by the response. From that point of view he thought this series of lectures had had an extremely successful initiation.

He saw that a number of students were present, mostly, he believed, from the Imperial College. As a Governor of that college he appealed to them to consider taking up work in the Colonies, work which was extremely interesting and had a touch of romance. He therefore directed their attention to the posts which it was hoped would become available in the Colonies for this type of work.

He then called for a very hearty vote of thanks to the lecturer, which was duly accorded with acclamation.

TRENDS IN EXPLORATION OF MINERAL DEPOSITS[1]

By Lowell B. Moon
Chief, Mining Branch, U.S. Bureau of Mines

Regardless of how a mineral deposit is first discovered or by whom, any mining enterprise based upon it must pass through a preliminary stage of exploration. The common understanding of " exploration " among mining engineers is well expressed by Jackson and Knaebel (*U.S. Bur. Mines, Bull No.* 356, 1934, p. 3) :

> " Exploration work ranges from that performed by the individual prospector employing only the simplest tools and equipment to elaborate campaigns involving the expenditure of large sums of money and the use of churn- or diamond-drilling equipment, large test-pitting crews, or sometimes a regular mining organisation. In any event, the object is to determine as accurately as possible, with the funds available, the size, shape, and other physical characteristics of the orebodies and their average value or grade."

The mining engineer, in his exploration of a deposit, is primarily concerned with " putting a pick in the ground " to determine the economic possibilities of the deposit. He is concerned with actually seeing and testing representative parts of the deposit, with determining the grade of the ore and how it can be treated, with delimiting the minable part of the deposit and calculating its tonnage, with finding how well the walls of the deposit will stand and how much water will have to be handled during the mining, and with interpreting what he sees and finds from his tests. In his interpretation he is concerned with answering the questions : " How much of the deposit can be mined ? " " By what method can it best be mined ? " " How can the ore be treated ? " " Where can the product be marketed ? " All these questions, of course, actually resolve into one : " Can a mining enterprise be based on the deposit ? "

Many methods have been devised for " putting a pick in the ground " to explore mineral deposits. During the last five years the Bureau of Mines has utilised most of the available tools.

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[1] Reprinted from *U.S. Bureau of Mines Information Circular No.* 7312 (March 1945) in the belief that the methods of exploring mineral deposits it describes will be of interest to those concerned in developing mineral deposits in the Empire.

The development of dirt-moving equipment has made it possible to remove overburden at low cost. It has become axiomatic in the Bureau that in most cases it is wise to explore first the " zero level " of deposits that come to the surface. The bulldozer has proved to be one of the most useful tools in surface work, although dragline scrapers, stump pullers, and several types of power shovels have their places. The particular advantage of the bulldozer is its versatility. It is useful not only in exposing the " zero level " of the deposit but also in the auxiliary heavy work that accompanies most exploration. At one Bureau of Mines project it was used to trench through clayey overburden as much as 20 ft. thick, to clear brush, to uproot and remove trees, to build roads, to transport large samples, to clear out an old open pit preparatory to sampling, to move a truck-mounted churn drill when mud or snow prevented self-propulsion, to prepare drill sites, and to clear snow from roads.

The reason for development of the " zero level " is to establish the size and extent of the deposit in two dimensions and to expose the top of the orebody so that it can be sampled. Once the trend of a deposit has been established, trenching can be done systematically to permit representative sampling. A wide deposit is most effectively exposed for sampling by regularly spaced, parallel, crosscut trenches. A long, narrow deposit can often be exposed along its entire strike length.

If results of sampling the " zero level " warrant exploration in the third dimension, or if the deposit does not occur close to the surface, some method of deeper probing is necessary. Where surface indications are so good that there is no doubt the deposit will be mined, or where the values are so irregularly distributed that only tonnage samples will be representative, " man-size " openings such as test pits, shafts, adits, drifts and crosscuts usually follow surface exploration. If quick, comparatively cheap information in the third dimension is needed, some sort of drilling usually precedes exploration by " man-size " openings. A deposit in which the values are regularly distributed so that representative samples can be obtained from small openings may be explored entirely by drilling. A large deposit close enough to the surface to be mined by open pit usually is explored by drilling because larger, more costly openings would be of no value later during the mining operation. If the deposit occurs at great depth, the quickest and cheapest method of exploration is by drilling.

The advantages and disadvantages of the several usual types of drilling are commonly known. The churn drill is widely used in many types of deposits. The diamond core drill is probably the most generally useful in " hard-rock " deposits and is, of course, particularly valuable where angle holes are needed.

The bucket drill, or " California cesspool digger," was first used to explore a mineral deposit in the dry placers at Atolia, Calif.[1] It makes a bore 12 in. to 30 in. in diameter. The Bureau of Mines has found it of great value in obtaining large samples of shallow deposits of material that is comparatively soft but that stands well. It was very effective to a depth of 120 ft. in the Batesville (Ark.) manganese deposits, even though occasional boulders had to be blasted, and in the Coso (Calif.) mercury deposits, even though hard layers of opalite were encountered.

The truck-mounted "seismograph" drill has proved to give excellent "undisturbed" samples of bauxite and clay. It is especially well adapted to penetrating thick, bouldery overburden. A power auger mounted on a trailer has been used effectively in drilling through boulder-free overburden and sampling underlying bauxite in Alabama.[2] The samples are somewhat contaminated by being lifted through the overburden, but the cheapness and speed in shallow deposits are remarkable.

In drilling and sampling a deposit of soluble salts in Utah, the Bureau[3] of Mines used a standard oil-well rotary rig. To minimise solution of the salts that were cored, a drilling mud containing the same salts in solution was used. A wire-line core barrel was used in coring the salts. With this apparatus a core could be taken from a depth of 3,000 ft. in 15 minutes instead of the 3 or 4 hours that would have been consumed with the more common core barrel requiring removal of all the drill pipe each time core is pulled. From the point of view of securing a good sample, the wire-line core barrel had the further advantage of keeping the highly soluble salts in contact with the mud solution in the hole for only a brief time.

Dupuy has described a novel method of sampling a gold deposit in dry ground,[4] without the usual "slugging of values" caused by concentration of the gold at the bottom of the hole when wet churn or diamond drills are used. A pneumatic wagon drill was used dry in conjunction with a vacuum sample collector. Vertical holes as deep as 150 ft. were drilled and successfully sampled by this method.

Exploration of a deposit by drilling is primarily to determine whether a mining enterprise can be based on it. The samples extracted and the information obtained from them are the objective, not the holes. Drill holes should be placed on a regular pattern in order that the samples obtained will be representative of the deposit. They should crosscut the deposit as nearly as possible at right angles. The objective of obtaining all possible information should be kept in mind at all times, even though the holes consequently progress more slowly. Most of these precautions are axiomatic, but operators tend to make a record for speed at the expense of the accuracy of the information obtained.

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[1] Prommel, H. W. C., Sampling and Testing of a Gold-Scheelite Placer Deposit in the Mojave Desert, Kern and San Bernardino Counties, Calif.: *U.S. Bureau of Mines Inf. Circ. No.* 6960, 1937, 18 pp.

[2] Dupuy, Leon W., Power-Driven Auger Drill Cuts Exploration Costs. *Engng. Min. J.*, Vol. 145, December 1944, pp. 98 and 99.

[3] Bureau of Mines, "Thompson Magnesium Well, Grand County, Utah." *War Minerals Rep. No.* 12, 1942, 39 pp.

[4] Dupuy, Leon W., Sampling the Picacho with Drill and Vacuum Collector: *Engng. Min. J.*, Vol. 141, 1940, pp. 29-31.

Time and money may sometimes be saved by a combination of " man-size " underground openings and diamond drilling. A shaft or a crosscut will often provide a new base of operations from which holes may be fanned to penetrate parts of a deposit that would otherwise be accessible only by long holes that would intersect the deposit at oblique angles.

In some cases enough information will be derived from drilling to permit development and mining to proceed without further exploration of the deposit. This applies particularly where the treatment method is established and where mining is to be by open pit. If the treatment method is not established, a necessary part of the exploration of the deposit is to take bulk samples representative of the ore and to determine in the laboratory or pilot plant how the ore can be beneficiated. If the deposit is to be mined by underground methods and there is any doubt as to the strength of the walls or the volume of water that must be handled, or if the grade of ore is not sufficiently well established, drilling should be followed by " man-size " underground exploration that will provide the lacking information. It may be desirable to mine some of the ore experimentally to see how the walls stand.

There is no best method of exploring all mineral deposits, but there is usually a best method or combination of methods to explore any given deposit. Although it may seem paradoxical, the same factors of size, shape, attitude, hardness, water content, character of wall rock, and distribution of values that are to be determined by exploration are those that guide the selection of method. A thorough preliminary examination by an engineer cognisant of the problems to be solved and familiar with the methods and equipment available will point the way to the most expedient procedure.

As the higher-grade and more easily accessible deposits are depleted, two trends in mining, and consequently in exploration, are developing. The first is the result of the necessity to gather up the comparatively high-grade " crumbs " of ore left in small and out-of-the-way deposits. The second is toward exploration and utilisation of large but lower-grade or more deeply situated deposits.

Because the stakes are small, few deposits in the first category will be able to stand the expense of elaborate exploration campaigns. The decision of whether they are worth exploiting will be made on the basis of surface exploration, with a minimum of preliminary third dimensional information. If considerable exploration of this type is undertaken, many ingenious combinations of portable equipment may be developed. A four-wheel drive truck similar to some of the present army equipment could have mounted on it a small compressor and a winch that could be used for hoisting or to run a drag-line scraper for trenching. The scraper could also be used for mucking exploratory adits or inclines. In country requiring much trail building, another type of outfit could be built around a tractor as the prime mover. The tractor would, of course, be equipped with a bulldozer blade. A compressor winch, even a small diamond drill for obtaining third dimensional information, could be mounted on a trailer that would be pulled by the tractor. A power take-off would permit running a small crusher, perhaps some simple washing equipment. It seems unlikely that exploration of the small, inaccessible deposits will become much more refined than at present. More portable equipment will be available, however, and may be combined into compact, general-purpose outfits that would be useful for whatever type of exploration might be required. Such outfits could perhaps be pressed into service to mine out small deposits. If attended by an auxiliary " jeep " for transportation of fuel and supplies, they would be quite versatile.

As lower-grade or deeper deposits are considered for exploitation, mining costs per unit of valuable mineral will rise, and the margin of profit will become slimmer, assuming constant prices. In dealing with deposits whose chance for exploitation depends upon a large capital outlay, skilful management, and recovery of low values, where the possible margin of profit is very small, the maximum amount of preliminary information will be required. Not only will the amount of exploration be increased, but the ultimate information will be obtained from the openings made and from the samples taken. Particularly for deep underground mines, faults and fissures in the wall rock near the deposit will assume added importance in determining the feasibility of mining. In deeper mines the strength and elasticity of the wall rock may control its supportability to some extent. These and other measurable physical properties may influence the drillability and breaking qualities of the rock and of the ore. The Bureau of Mines has begun a series of tests on drill cores from operating mines to determine strength, elasticity, abrasiveness, and other physical properties and to correlate them if possible with mining methods that are in use or could possibly be used. If such correlations could be established, the information obtainable from drill cores would be increased considerably.

Although there will undoubtedly be many refinements in equipment for making " man-size " and drill-hole openings for the exploration of mineral deposits, the fundamental types of equipment now in use probably will continue to be employed for a long time. A greater advance may be made in the amount of information gleaned from the openings.

This is not the place to discuss geophysical methods, but as more sensitive, accurate methods are developed, drilling holes to determine the size, shape and exact location of mineral deposits may be minimised. Geophysics probably will be used as another tool in the exploration *of* deposits in addition to its present rôle in the exploration *for* deposits. Drill holes and other openings for extracting samples will continue to be needed, but the targets may be more precisely determined in advance.

As the geophysicists acquire added skills in detecting " blind " deposits, it will be necessary to hit comparatively small targets at greater depth with drills. Much is known about anticipating and controlling the direction and inclination of drill holes, but more will be learned. Further advances will be made in the surveying of drill holes.

To make possible the exploitation of the " crumbs " of higher-grade ore and large but lower-grade or deeper deposits, it will be necessary for the engineer in charge of exploration to consider other things besides the techniques of making openings and of obtaining information from the samples. All possible advantages in local markets will have to be investigated. It cannot be considered as necessarily fixed that the concentrate specifications of a distant existing reduction plant must be met. The existing industries based on domestic raw materials did not develop as a result of trying to supply a foreign market. The copper industry in the United States would not have developed if we had continued to ship western ore to Swansea, Wales, as was done in the early days. Because of the present size and solidarity of certain parts of the mineral industry, we are prone to consider that the only chance of successful exploitation of a mineral deposit is to supply a product that meets fixed specifications. We forget that those specifications were originally fixed to meet the characteristics of available raw materials. Because the product of a deposit cannot meet the fixed specifications is not sufficient reason to give up. Combining a mineral with complementary industrial raw materials as close as possible to its source should be considered. If a market for the product that would result does not exist, perhaps one can be created.

The stone age man who first smelted iron ore probably did not do it to satisfy an existing need. It is likely that after he had accidentally obtained the iron he thought of a way to use it.

Mining is, of course, only one part of the mineral industry pattern, but it deals with the only part of the pattern that is necessarily fixed—the mineral raw materials. Fixed, not in the sense that we must continue to use the same raw materials, but fixed in the sense that we cannot change the manner in which they occur in nature. All the techniques of mining, ore dressing, metallurgy, and fabrication, as well as the uses for the final products, are man-made and can be changed and improved. Most of the minerals mined will continue to be used in the established pattern, but the possibility of locally altering the pattern to fit available raw materials should not be overlooked.

When a deposit has been explored, when the engineer has found out all he can about it with a reasonable expenditure, he is in the same situation as the stone age man with the piece of iron. His job is to find a use for it.

As stated in the beginning, the purpose of exploration of a mineral deposit is to answer the question : " Can a mining enterprise be based on the deposit ? " If the answer is to be " Yes " in the future, the technique of making openings and particularly of gleaning information from samples taken must be improved. In addition, every possible technologic and marketing advantage must be sought, and seeking for it must be considered an essential part of the exploration.

ABSTRACTS AND NOTES

Obituary.—Dr. E. F. Armstrong. It is with much regret that we have to record the death on December 14, 1945, of Dr. E. F. Armstrong, D.Sc., Ph.D., LL.D., F.R.S., F.R.I.C., M.I.Chem.E. He had been a member of the Imperial Institute Consultative Committee on Chemical Industries for the last decade and had in recent years been its Chairman and also a member of the Advisory Council on Mineral Resources. In addition to his high scientific standing, Dr. Armstrong was also in later years an outstanding figure in all that concerned the British chemical industry. With such an exceptionally wide knowledge of chemistry and of the chemical industry he was an invaluable member both of Committee and Council.

Uranium and Thorium Restrictions in South Africa. The Union of South Africa Government Gazette of October 5, 1945 (No. 3554), includes a proclamation (No. 212 of 1945) restricting the prospecting, working, and export of ores containing uranium and thorium. This proclamation repeals one of so recent a date as September 18, 1945 (No. 197 of 1945), which, though similar, applied to uranium only.

The regulations annexed to Proclamation No. 212 of 1945 vest the State with the sole right to search or prospect for, mine or dispose of any uranium or thorium, or, by any chemical or metallurgical process, to extract or isolate any uranium or thorium from any substance whatsoever ; and to export any uranium or thorium from the Union.

No person shall, without the written authority of the Minister of Mines, (*a*) prospect for or mine any uranium or thorium referred to in the schedule to the regulations, or, by any chemical or metallurgical process, extract or isolate uranium or thorium from any substances whatsoever ; (*b*) export any such uranium or thorium.

An authority to carry out any of the operations of the last paragraph may be granted, subject to such conditions as the Minister of Mines may deem fit to impose. Further, the Minister of Mines is empowered to prohibit any person from carrying out any of the operations of the last paragraph if the Minister is satisfied that the person is performing or is about to perform those operations under circumstances in which the provisions of the previous paragraph may not apply.

The Government Mining Engineer, the Director of Geological Survey, their deputies and certain other Government officials are empowered to enter upon any land or premises to make tests and to remove samples for determining the presence or otherwise of uranium or thorium. Every person who has before or after the commencement of these regulations discovered that uranium or thorium occurs at any place in the Union or the Mandated Territory of South West Africa must report the occurrence forthwith.

Penalties are prescribed for contravention of these regulations, which regulations apply also in the Mandated Territory of South West Africa. For full details, the regulations should be consulted.

The minerals mentioned in the schedule are: autunite, allanite, betafite, carnotite, curite, euxenite, fergusonite, gummite, meta-torbernite, monazite, pitchblende, samarskite, soddite, thorianite, thorite, thorium, torbernite, tyuyamunite, uraninite, uranium, uranophane, uraconite, xenotime.

" Uranium " and " thorium " in the regulations include all natural substances, chemical compounds and physical combinations of which the element uranium or the element thorium, as the case may be, is a constituent.

A. W. G.

Federated Malay States, Geological Survey.—When Malaya fell into the hands of the Japanese all the officers of the Geological Survey Department were interned, except one who managed to escape. News has been received by the Imperial Institute that the headquarters office at Batu Gajah has been found to be in much better shape than had been anticipated with abouty eighty per cent. of the records intact. The office and records narrowly escaped destruction in January, 1942, when a Japanese tank section, which had occupied the building, attempted to burn it down. When they took their departure they made a pile of the records, maps, books, etc., and set fire to them, but by prompt action the chief clerk and his assistants succeeded in extinguishing the fire and saving the building and the greater part of the records and papers. At the district offices in Kuala Lumpur, Kuala Lipis, Bentong and Kuantan, however, all the equipment and records have disappeared and have probably been destroyed.

Fortunately, a number of the unpublished records of the more recent geological work were stored at the Head Office in Batu Gajah, and these have been found intact. About fifty per cent. of the more recent, unpublished, survey work has been saved. Up to mid-December no trace had been found of the unpublished work of only three of the geologists, F. T. Ingham, J. B. Alexander and F. W. Roe, whose records were left in the district office in Kuala Lumpur or were taken and stored in Singapore.

All the officers of the Geological Survey are now reported as being safe.

Fine Grinding Plant.—A product of extremely small particle size is frequently called for in ore dressing; for example, fine grinding is often necessary in order to make a material amenable to a subsequent chemical or physical process. Non-metallic minerals too, of which talc is a good example, also need to be produced as very fine powders in order to make them into saleable products. Equipment capable of reducing such materials to very fine grain sizes without uneconomically long grinding or excessive wear on the machines is therefore of direct concern to mineral producers and processers in many parts of the world. Three new American mills recently described in *Chemical and Metallurgical Engineering* (1945, 52, No. 4, 125-127), will therefore be useful additions to the already existing equipment capable of producing ultra-fine powders. The first of these is a new, mechanical screenless pulveriser known as the Mikro-Atomizer, which is capable of reducing certain materials to as fine as 1 or 2 microns. It consists essentially of a rotor with a special form of impact members and special means of returning oversize particles back into the path of the rotor. The finished product is picked up in an air stream and discharged into a conventional type of collector.

The Eagle mill, developed by the well-known pencil company of that name, grinds merely by passing the substance to be ground, for example, graphite, in air or inert gas suspension, through an extremely long pipe which is in circuit with means for withdrawing the product when it has reached the requisite particle size. Wear, except on the nozzle, is said to be extremely low.

The De Anza mill, invented by a mining engineer, operates on the principle of mutual abrasion of particles of the material by one another without the use of auxiliary beating or crushing components. According to the author, the mill consists essentially of a rotating bowl mounted on a horizontal axis which is revolved at a speed from 1,200 to 2,000 r.p.m., depending on the size of mill. The speed is chosen to secure an attrition velocity of about 300 ft. per second. In addition to the rotating bowl there is a slowly rotating drum, turning at 6 r.p.m. or faster, depending on the fineness of product desired, which acts as a material elevator and recirculator, holding material in the grinding circuit until particles are fine enough to leave the mill by way of either a wet or dry classifier. To carry out this function, the drum is equipped with lifters around the periphery and is carried on circumferential tyres and rolls in the manner of a rotary kiln.

Material elevated by the lifters is chuted into the rapidly rotating bowl. Centrifugal force holds a layer of material within the bowl, and it is the action of material falling upon this rapidly spinning layer which accomplishes the grinding. The only wearing part of the mill is the retaining ring at the mouth of the bowl, and it is claimed that only nominal wear takes place on this readily replaceable part. Actually, according to the manufacturer, there is so little wear that metallic contamination of the material ground cannot be detected.

E. R. V.

BOOK REVIEW

Books for review should be addressed to "The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

CHEMICAL CRYSTALLOGRAPHY. By C. W. Bunn. Pp. xii + 422, 9½ × 6. (Oxford: The Clarendon Press; London: Humphrey Milford, Oxford University Press, 1945.) Price 25*s*.

The increasingly important rôle played by crystallography during recent years in the development of chemical theory and as an accurate and ready means of identifying solid substances is certainly one which is insufficiently appreciated by industry in general. It is a matter, therefore, of some moment that a work of the calibre of the one under review comes to be published, setting out as it does in a clear, authoritative and interesting way the fundamental principles of optical and X-ray methods of investigation. The author is exceptionally well qualified for this task, having for many years been associated with the Research Laboratory of Imperial Chemical Industries, Ltd. (Alkali Division) at Northwich in Cheshire, probably one of the finest industrial crystallographic laboratories in the country.

To ensure that the present work shall have the widest appeal, the author has assumed that his readers have had no previous knowledge of crystallography, and, moreover, he has included only the barest outline of physical theory necessary for the general understanding of the principles and methods described.

The work falls naturally into two sections of unequal length, the first comprising four chapters and consisting of 116 pages, dealing with the use of crystal properties for the practical identification of substances. An introduction is given to the shapes of crystals and the relation between shape and structure, the principle of the reflecting goniometer being outlined and the method of stereographic projection described. This is followed by an elementary account of crystal optics (29 pp.) and a chapter (12 pp.)

on the identification of transparent crystals under the microscope, largely by means of the immersion method. The section ends with a chapter (25 pp.) on identification by X-ray powder photographs, based on the fact that each crystalline substance has its own set of plane-spacings, which is different from those of other crystalline substances. Moreover, as the relative intensities of the various reflections are also characteristic, each substance gives its own characteristic powder photograph. For ease of reference and for identification purposes, these may be conveniently classified in a card index according to the spacings of the strongest arcs or lines. Thus in the card index published by the joint committee of the American Society for X-ray and Electron Diffraction and the American Society for Testing Materials, there are three cards for each substance, one for each of the three strongest arcs ; consequently, measurement of the second and third strongest arcs, followed by reference to the index, may lead to unequivocal identification, which, however, should only be accepted as final when the whole pattern is compared with that in the index and found to agree, both in spacings and relative intensities.

A mixture of two or more substances gives a pattern consisting of the superimposed patterns of the individual components, provided these exist as separate crystals in the powder specimen. This is illustrated in the case of Portland cement and in bleaching-powder.

From this point onwards the author is mainly concerned with the determination of the arrangement of atoms in crystals, and he therefore devotes his second section to " structure determination," which he deals with in six chapters, comprising 246 pages. He begins with a comprehensive discussion (62 pp.) on the determination of unit cell dimensions, this in turn being followed by a detailed account (88 pp.) on the determination of the positions of the atoms in the unit cell by the method of trial and error. A short chapter (14 pp.) now ensues on the evidence on crystal structure deducible from physical properties such as shape and cleavages, optical and magnetic characteristics, and piezo- and pyro-electric behaviour, the author here describing some very interesting examples. Several examples of the complete process of structural determination are given in chapter 9 (43 pp.), the structures described being all relatively simple ones, and chosen on the ground that they illustrate the application of the essential principles in relatively simple circumstances. The examples given are (1) calcium oxide (CaO) ; (2) cuprous chloride ($CuCl$) ; (3) titanium dioxide or rutile (TiO_2) ; (4) urea ($O=C(NH_2)_2$) ; (5) sodium nitrite ($NaNO_2$) ; (6) sodium bicarbonate ($NaHCO_3$) ; (7) *p*-diphenylbenzene ($C_6H_5.C_6H_4.C_6H_5$) and dibenzyl ($C_6H_5.CH_2.CH_2.C_6H_5$) ; (8) ascorbic acid (Vitamin C) ; (9) long-chain polymers (e.g. β-gutta-percha and rubber hydrochloride).

Two comparatively short chapters bring the work to a close, the first (27 pp.) dealing with electron density maps and vector maps, which give a picture of the crystal structure, and the second (12 pp.) with broadened X-ray reflections and their interpretations.

Throughout the work the approach has consistently been from the chemist's point of view. It is excellently illustrated by means of 234 figures, including 13 beautiful half-tone plates. There are, moreover, five appendixes on (1) immersion liquids and their standardisation; (2) the spacings of crystal planes; (3) charts showing the relation between plane-spacings and axial ratios, constructed without calculation; (4) proof that reciprocal points form a lattice; (5) list of space-groups. Two indexes are also provided, one a reference and name index, and the other a subject index.

E. H. B.

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EMPIRE EDUCATIONAL FACILITIES

EXHIBITION GALLERIES, LANTERN SLIDES, FILMS, LECTURES, Etc.

NOTES

Exhibition Galleries.—The half-year covered by this issue of Exhibition Galleries Notes has seen the passing of the World War, but not, as most people have already discovered, the passing of war-time conditions. Of the latter, lack of manpower seems to be a predominant feature, and this factor more than any other has prevented the return of the Exhibition Galleries to their pre-war footing of all day and every day opening. Thanks, however, to the manner in which the members of the Women's Voluntary Services and other ladies have responded to our appeal and re-assembled to place their services as official custodians at our disposal, we have been able to revert to the part-time opening which, as already recorded in earlier issues of these Notes, marked the less strenuous periods of the war-time enemy attacks on London. By these means, throughout the past half year, the Empire Courts have been available for public inspection on every weekday afternoon from 2 p.m. to 4.30 p.m., together with one three-quarter hour session of Empire films in the Cinema, starting at 3.30 p.m. In addition, as has been the case throughout the whole of the war, the Courts have remained available to organised parties, by pre-arrangement, at any mutually convenient time within normal office hours, a facility which has also been granted to individual visitors who made personal requests at the Inquiry Office.

The overall response to these general facilities has been very gratifying. During the six months under review, the Galleries have been visited by 38,502 persons, of whom 9,315 were comprised in 207 parties. Of these latter parties, personnel of the various Fighting Services have preponderated, and the chief constituent commands, and purposes for which their troops made visits, may be summed up as follows.

Many parties of Overseas troops, mainly of the Canadian and Indian armies, have come to renew acquaintance with their various home countries, while groups from S.E.A.C., from the W.R.N.S. and A.T.S. on delegation to Overseas countries have come to obtain a background knowledge of the country to which they will eventually proceed.

Parties of various troops, but notably of the Guards, the Royal Artillery and the Royal Pioneer Corps, have paid visits as part of their normal educational courses. In this latter connection, the Army Educational Corps have not only brought parties of troops but have sent their instructors in Empire geography to attend officially conducted sessions, so that they in turn may conduct their own parties later on.

The next largest group of visitors consists of school classes, many under the guidance of their own teachers, but more frequently with a request for official guidance and explanation of the exhibits. Indeed, the overall demand for guide lecturers both from troops and schools had become so great that it could not have been fully met but for the return to duty in September of one of the Institute's official guide-lecturers from the Middle East theatre of war.

Apart from this definitely educational rôle played by the Empire Courts, they have served a very useful purpose in bringing home to even the most casual visitor the important part which Empire products play in his everyday life.

This story of the Empire's team-work which is continually going on, both in war and in peace, is one which cannot be too frequently told, and its " visual telling "—by means of diorama, story exhibit, model and pictorial travelogue as practised in the Exhibition Galleries—provides just the right background for its absorption. Small wonder is it, then, that the remark most frequently heard from provincial visitors is " Lucky Londoners to have a place like this at their doorsteps, easy of access and providing up-to-date Empire information in new and attractive forms."

Nor is this appreciation merely verbal, for more practical methods can be recorded in the fact that the Governments of Udaipur, Jaipur and Baroda have now decided to join other Indian States in installing and maintaining their own Courts, and that the Government of Hyderabad wish to acquire more exhibition space with the object of improving on their present displays. These decisions have necessitated an extension of the Indian States section into the southern end of the Exhibition Pavilion. The construction of the necessary equipment (dioramas, showcases, transparency fittings, etc.) is now well in hand.

Other practical forms of appreciation which should be noted are donations from Mr. G. D. Birla and Mr. G. S. Lall to provide dioramas for the Indian Court; from Mr. Chand Mull for the improvement of the Indian mica display; from the Government of Burma for a new diorama for the Burma Court; and from the Hudson's Bay Company to provide a bronze statuette of Henry Hudson for the Canadian Court.

Plans for more colourful and more dynamic displays are in project for a number of other Courts and these will be put into effect as funds, man-power and materials become available.

During the period under review the Empire Courts have received their usual quota of visits from officers on leave from the Colonial Empire. A list of them appears on pages 348 and 349.

It is an honour and a pleasure to record a visit to our Exhibition Galleries on July 2 by Queen Mary, attended by Lady Cynthia Colville and Major the Hon. John Coke, when Her Majesty inspected exhibits in the East, South and West Galleries.

Among other distinguished visitors who have been received by the Director and have either made a tour of the Exhibition Galleries or visited the Empire Courts in which they were particularly interested were:

June 8: Mr. S. G. Vesey Fitzgerald, M.A., Barrister at Law, I.C.S. (Retired). Lecturer in Indian law, University College, London.

June 11: Dr. Cronje, South African delegate (from the South African Wool Board) to the International Wool Publicity Research Secretariat in London.

July 7: Mr. J. A. Stendall, Curator, Municipal Museum and Art Gallery, Belfast.

July 10: Sir Raibeart MacDougall, K.C.M.G., C.I.E., I.C.S., Counsellor to the Governor of Burma, accompanied by Lady MacDougall and Miss MacDougall.

July 25: Sir Stewart Symes, G.B.E., K.C.M.G., D.S.O., Governor-General of the Sudan 1934-1940, accompanied by Lady Symes and Mrs. Creighton-Stewart.

July 27: Mr. H. M. Hake, C.B.E., F.S.A., F.R.Hist.S., Director, National Portrait Gallery.

July 30: Mr. W. V. Grigson, C.S.I., I.C.S., Revenue and Police Member, Government of Hyderabad.

August 1: Dr. H. Crookshank, B.A., Director, Geological Survey of India.

September 7: Mr. J. P. Raffray, C.B.E., K.C., Member of the Executive and Legislative Councils of Mauritius.

September 11: Sir John Merrick, C.M.G., O.B.E., Chief Secretary, Uganda Protectorate.

October 12: Dr. J. R. H. van Nouhuys, Director of the Fibre Institute, Delft, Holland.

The Alaska Highway.—Although war is in the main a destructive business, it does at times leave behind some results of a permanently useful nature. One of the most important undertakings planned and completed under the impulse of the World War which has just passed was the building of the highway and aircraft staging route which now traverses Canada, connecting the United States with Alaska, and popularly known as the "Alcan Highway."

The Japanese attack on Pearl Harbour created an immediate menace to the western seaboard of North America, namely the Pacific coasts of both the United States and Canada. In particular the sea route—the only route for supplies—between Alaska and those strategically important outposts, the Aleutian Islands, was jeopardised. Under the force of such circumstances, the two Governments concerned at once decided to build to Alaska an alternative land route which would be sheltered by the high mountain ranges extending north and south through the Canadian Province of British Columbia and the Yukon. This route was also designed to link together five small airfields already constructed and lying between Edmonton in Alberta and Whitehorse in the Yukon, the whole distance being nearly one thousand miles.

The first step taken was to enlarge the airfields. Then, as soon as large aircraft could land on them, armies of workmen were flown north to build the sections of road to join them. From each airfield two parties equipped with the heaviest bulldozers drove north and south, forcing their ways through country scarcely surveyed except from the air, in order to make contact with each other.

Fuel was needed both for aircraft and motor vehicles, and for this purpose the recently discovered oil field at Fort Norman, just south of Great Bear Lake, was developed, its oil being pumped six hundred miles through a hastily constructed pipe line to an oil refinery at Whitehorse.

All the several projects were started within a few weeks of each other in 1941, and all were in successful operation by November 1942. The manner in which this huge engineering feat was carried out is well illustrated by a set of photographs supplied by the National Film Board of Canada, through the kind offices of Sir Stephen Tallents, K.C.M.G., C.B., C.B.E., and now on exhibition in the Canadian Court.

For Canada, this new highway has opened up vast tracts of territory formerly only inhabited by small groups of settlers, and has made accessible new areas of land, rich in oil and other minerals, and potentially valuable for agricultural and forest exploitation.

Empire Lantern Slide Library.—During the six months April 1945 to September 1945 covered by this report, 23,220 lantern slides have been issued to schools and lecturers in the United Kingdom. The details are shown below:

	April	May	June	July	Aug.	Sept.
United Kingdom . .	180	180	60	180	300	540
Canada . . .	1,020	840	360	180	120	600
Australia . . .	420	300	360	120	—	240
New Zealand . .	120	300	420	240	—	180
South Africa . .	60	240	240	180	—	60
India . . .	540	300	240	840	300	60
Burma . . .	420	120	540	360	120	660
The Colonial Empire .	2,100	2,100	2,220	900	420	1,620
Products of the Colonial Empire. . .	—	—	180	60	—	60
General Tours . .	120	360	60	—	—	60
History . . .	120	—	—	180	—	120
	5,100	4,740	4,680	3,240	1,260	4,200

Three new Picture Talks on India have been written by Sir John Cumming, K.C.I.E., C.S.I., M.A. The first talk on "Rural India" emphasises that although India is among the eight leading industrial countries of the world, it is still primarily an agricultural country in which four-fifths of the population live and work in rural areas. As a preliminary to a description of crops grown, general village life is illustrated by typical street scenes in a model village, the market, and the village well.

The differences from English rural life become clear after pictures have been seen showing types of agricultural instruments employed in India, the use of oxen where we should use horses or tractors, and the cultivation and production of rice, sugar, tea and coconuts.

After a reference to the tragic burning of animal manure as fuel, Sir John deals with the fishing industry and the minor rural industries, the cobbler, the brickmaker, and the carpenter, concluding with pictures of children at work and play in the village schools.

In the second talk on the "Peoples of India," written in the form of a circular tour of the whole sub-continent, the emphasis is on the diversity, variety and size of India's population. Men, women and children of many types are shown in their ordinary occupations and on special occasions, such as weddings, so that we see their houses, clothes, ornaments and something of their customs and religions. The keynote of the talk is India as a land of many peoples.

In his third talk, "India's Old Time Buildings," Sir John deals with the prehistoric remains, Buddhist Stupas, Jain memorials, rock excavations, Hindu temple architecture, and Moslem buildings.

In anticipation of the time when schools will be equipped with film strip projectors, the illustrations for sixteen of the picture talks in the Library have been made into film strips, and are now available for loan. All new talks will be made into film strips.

Central Film Library.—The circulation of films for the six months May to October is shown below:

	Empire.	G.P.O.	M.O.I.	Total.
May . . .	2466	370	4584	7420
June . .	2073	369	3843	6285
July . . .	1794	259	3205	5258
August . .	491	79	2221	2791
September .	1782	284	3316	5382
October . .	3225	486	5160	8871

The remainder of the films made by Mr. R. Kingston Davies in East Africa in 1938 have been added to the Library, and all twelve films of this series are now in circulation. They are 16 mm. silent, and the titles are:

Peoples of Kenya . . .	The Somalis and the Boran tribes.
Peoples of Tanganyika . .	Life of the people in Mbeya and Mbulu districts.
Shamba Ya Kahava . .	Cultivation and harvesting of coffee.
Shamba Ya Chai . . .	Cultivation and harvesting of tea.

K.A.R. Signals	The Kings African Rifles.
Shamba Ya Katani	The Production of sisal.
B'wana M'Shamba	work of an agricultural officer.
Bugufi	How hoes are made in Bugufi by native craftsmen using only local materials and tools.
Kigezi	The mountainous district in the extreme South West corner of Uganda.
Ankole	Comparing " Hamitic " and " Bantu " peoples.
Katwe	Working the salt lake.
Bwamba	A primitive African community.

Two new films on West Africa are now available. They are " Mamprusi Village," showing life in the Mamprusi district of the Gold Coast, where the responsibilities of government are shared between the local chiefs and the District Commissioner, and "Achimoto College." These are the first of a new series of sound films on West Africa being made by the Ministry of Information for the Colonial Office.

The National Film Board of Canada has presented to the Library single 16 mm. prints of a number of colour films on Canada. Among the subjects covered are scenery, interpreted by Canadian landscape artists, the Great Lakes, Eskimo life, and Indian fur trapping. The distribution of these films is necessarily limited as there is only one copy of each, and it is impossible at the present time to obtain further colour prints.

Empire Lectures to Schools.—The popularity of the Lectures Scheme with the schools has continued to grow, and there are no signs of any diminution of the demand for this service. During the lecture season which ended in August 1945, 3,044 lectures were given to audiences aggregating 436,832 schoolchildren. The comparative figures for the previous lecture season were 2,177 and 329,429 respectively.

The need for the building up of a sound knowledge of Empire affairs and a sympathetic understanding of Empire problems is generally agreed. It is to be hoped, therefore, that the Institute's Lectures Scheme (initially a war-time measure) may become a permanent contribution to Empire education in the United Kingdom. Before this hope can be realised, however, the problem of an established financial basis on which the Scheme may operate will have to be solved.

A third conference of lecturers and school representatives was held on July 21 last. Continuing the very successful experiment made at the second conference (reported in a previous issue) an invitation to open the discussion was extended to Mr. G. H. McKay and Dr. M. F. Lowe, Lecturers of the Northern Polytechnic, Holloway. A memorandum prepared by Dr. Lowe had been circulated, and the conference applied itself to three main considerations: (1) " Why does the school ask for Empire Lectures ? " ; (2) " What does the school expect from the lectures ? " ; and (3) " What is the most effective lecturing technique ? " A keen and diverse discussion ensued, and not the least valuable contributions were made by three students of the Polytechnic, who had been invited to participate, on the recommendation of the second conference. The main object of the Scheme was well summarised by Dr. Lowe, who suggested that, while the teacher could provide a black-and-white sketch of the Empire, it was the lecturer to whom they turned to fill in the colour and to give " life " to the picture.

The recruitment of suitable lecturers has continued, and an intimate personal knowledge of some country or countries of the Overseas Empire has continued to be an essential qualification governing their appointment. Among those who have recently joined the Scheme are Dame Katherine Jones (South Africa, Sudan and Palestine), Miss H. M. Rolleston (New Zealand and East Africa), Mr. Peter Blackman (Barbados), Capt. John Green, lately of the Nyasaland Police (Rhodesia and Nyasaland), S/Ldr. B. S. Leete, O.B.E. (India and South Africa), Mr. Ivan Pedersen (South and East Africa), and Mr. David Schloss, B.A. (New Zealand, Australia and Ceylon. Lecture tours have already been arranged for several of these recruits to the Scheme, and most encouraging reports have been received from the schools visited.

Now that schools are returning to the towns and villages which they had had to evacuate owing to the war and the basic re-organisation of the educational system has surmounted its initial disturbance, the Lectures Scheme should have no difficulty in retaining a systematic and settled place in the teaching of Empire geography and in reaching parts of this country which war-time circumstances have hitherto restricted to a very limited participation.

Empire Schools Correspondence.—During the period of six months covered by this review lists of names of 701 children in South Africa and 215 children in India desirous of corresponding with students in this country, were received. Nearly all these applicants have been dealt with, suitable correspondents have been found, and evidence has been received that interesting contacts have been formed.

For reasons of security it has not been possible, during the war, for the Dominions of Australia and New Zealand to participate in this Scheme. With the cessation of hostilities in the Far East, however, the High Commissioner in London for the Government of Australia has invited the Institute to bring the Scheme to the notice of the Directors of Education in each of the six Australian States. The High Commissioner in London for the Government of New Zealand has also referred the matter again to his Government, and an early and favourable reply is expected.

Colonial Visitors.—The following is a list of officers on leave from the Colonial Empire who have visited the Institute during the six months ending November 1945 :

JUNE

DR. K. A. DAVIES, Director of Geological Survey, Uganda.
DR. F. DIXEY, O.B.E., Director, Geological Survey, Nigeria.
H. FRASER, Assistant Conservator of Forests, Tanganyika Territory.
DR. N. R. JUNNER, O.B.E., M.C., Director, Geological Survey, Gold Coast.
G. W. LOCK, Senior Agricultural Officer, Tanganyika Territory.
C. O. OATES, Senior Agricultural Officer, Kenya.
THE LATE F. OATES, M.B.E., Geological Survey Department, Tanganyika Territory.
DR. H. H. STOREY, Chairman, East African Industrial Research Board.

JULY

W. G. ALCOCK, Lands Officer, Nyasaland.
J. P. ATTENBOROUGH, Director of Education, Aden.
J. D. BROATCH, Senior Agricultural Officer, Gold Coast.
J. V. R. BROWN, Senior Agricultural Officer, Tanganyika Territory.
W. B. COLLINS, Assistant Conservator of Forests, Gold Coast.
H. HOWARTH, Public Information Officer, Palestine.
D. S. MILLER, Director of Education, Basutoland.
N. V. ROUNCE, Senior Agricultural Officer, Tanganyika Territory.
S. H. SHAW, Geologist, Palestine.
A. F. W. SHEFFIELD, Agricultural Officer, Nigeria.
C. L. SKIDMORE, Senior Agricultural Officer, Gold Coast.
C. C. WEBSTER, Agricultural Officer, Nyasaland.
J. K. H. WILDE, Veterinary Research Officer, Tanganyika Territory.
C. G. WISE, Master, Achimota College, Gold Coast.

AUGUST

V. A. BECKLEY, M.C., Senior Agricultural Chemist, Kenya.
P. L. BRADLEY, Agricultural Officer, Nigeria.
A. K. BRIANT, Agricultural Officer, Zanzibar.
G. O. CASE, Director of Public Works, British Guiana.
DR. A. E. S. MCINTOSH, Chief Research Officer, Malaya.
K. C. MURRAY, Education Officer, Nigeria.
W. E. NICHOLSON, C.B.E., Director of Education, Sierra Leone.
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